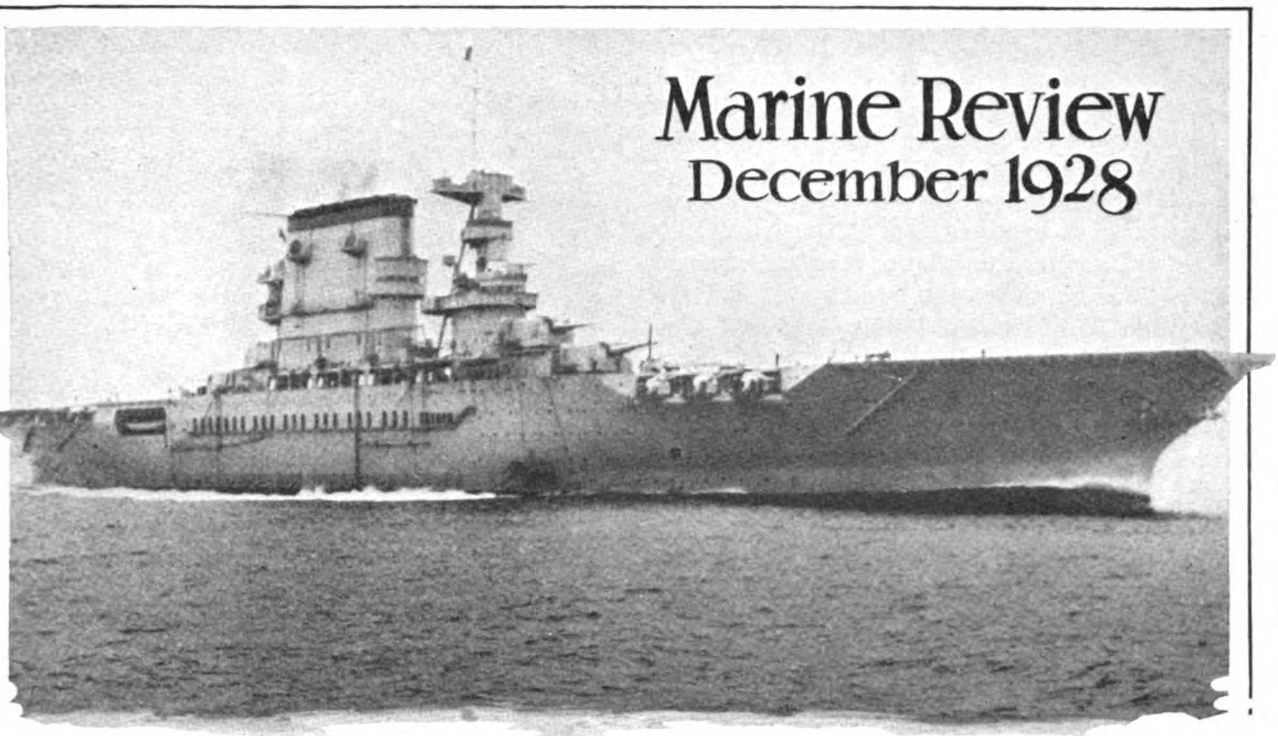

Airplane Carrier U. S. S. Lexington—On Nov. 15, 1928 This Vessel Made an Estimated Speed of 34.5 Knots

Strong Navy and Merchant Marine Needed for National Security

By Alfred H. Haag

WE ARE confronted by a lamentable situation in a matter affecting our national security. We have among us two kinds of propagandist, first the foreign propagandist who assumes the role of pacifist in order to further the interests of his own country to the detriment of ours; secondly, the well meaning pacifist who becomes the unwitting tool of the foreign propagandist and who is used as a catspaw in furthering the interests of foreign governments. Can it be possible that the opinions and advice of such persons shall receive serious consideration as against the sound judgment of those who have studied the subject and who have had opportunity to observe the activities of nations from both commercial and military standpoints.

In order that the American people may get a correct understanding of the situation affecting our sea power, the United States naval policy based on the Washington treaty for limitation of naval armament is hereby quoted:

"The treaty for the limitation of naval armament, when promulgated, will be the supreme law of the powers party to the treaty governing their naval armaments as to capital ships and aircraft carriers. The spirit of the treaty indicates two elements of international import: A general desire to avoid competition in naval armament. A partial recognition of a ratio in naval strengths as a means of avoiding competition. Were any power now to undertake a program of expansion in unrestricted classes of naval vessels or in personnel not consistent with the treaty ratios of capital ships, a new competition in naval strengths would thereby be initiated.

Until such time as other powers by inequitable conduct in international relations as to United States interests or by their departure from the idea of a suspended competition in naval armaments, indicate other procedure, the navy of the United States may be governed in naval strengths by the spirit of the capital ship ratios, otherwise it will be necessary appropriately to readjust our naval policy."

The intent of this policy can be construed in but one way—that in spirit and principle the

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The Sinking of the S. S. Vestris

Editorial

THE bare facts concerning the sinking of the VESTRIS, as accurately as they can now be determined, are: On Nov. 12 at 10:05 a. m. this radio message was received: "S. S. VESTRIS, Lamport & Holt line, latitude 37.35 north, longitude 71.08 west. Require immediate assistance." At 10:52 a. m. the VESTRIS radioed: "Hove to since noon yesterday. Last night developed 32 degree list; starboard decks under water. Ship lying on beam ends. Impossible to proceed anywhere. Sea moderately rough." And again at 11.07 a. m.: "Rush help. Ship sinking slowly." Then followed at short intervals a number of urgent messages of similar import until 1:25 p. m. when the last message came: "We are abandoning ship. We are taking to the lifeboats." Immediately following the sending of the first message ships within call changed their course for the position given with the view of rendering assistance. The first ship to reach the scene was the SAN JUAN of the Porto Rico line, at 5:45 p. m. Nov. 12. The SANTA BARBARA of the Grace line and the Japanese OHIO MARU arrived about 8:00 p. m. Nov. 12. Then followed the U. S. S. WYOMING and United States coast guard destroyer DAVIS arriving about midnight. Later came the AMERICAN SHIPPER, of the American Merchant line, the BERLIN of the North German Lloyd and the GIORGIO OHLSEN an Italian steamer; still later, and not at first reported, the French tanker, MYRIAN.

Ships Pick up Many Survivors

The first lifeboat from the VESTRIS was brought alongside of the AMERICAN SHIPPER at 4:00 a. m. Nov. 13, over 14 hours after the last SOS. All during that day and longer, careful search of the vicinity resulted in the saving of a total of 215. Of this number 60 were passengers and 155 ship's personnel. There were a total of 326 persons on board so that 68 passengers and 43 of the crew were lost. Of this number one report stated that 22 bodies were recovered. As this is written there is no hope that there are any additional survivors.

It is reported that there were 23 children on board and all were lost; also that only 10 women were saved. The carrying out of the inflexible tradition of the sea, women and children first, caused them to be placed in the first two lifeboats and these boats being on the high side, were not successfully launched.

The following tabulation gives the number rescued by each ship:

	Number Saved		
Rescue Ship	Passengers	Crew	Total
S. S. AMERICAN SHIPPER....	41	84	125
U. S. S. WYOMING...............	5	3	8
S. S. BERLIN..........................	6	18	24
S. S. MYRIAN.........................	8	50	58
	60	155	215

Stability Seriously Impaired

The S. S. VESTRIS, a Lamport & Holt passenger and cargo liner in regular service between New York and the East coast of South America, was built in 1912 by Workman, Clark & Co., Belfast, Ireland. She was 522 feet in length overall, 60 feet 10 inches in beam and had a gross tonnage of 10,494. On her last ill-fated voyage in command of Capt. William J. Carey she sailed from New York Nov. 10 bound for South America. A severe storm was encountered and the reports indicate that she was hove to from Sunday noon until about 2 or 2:30 p. m. on Monday when she went down. Her position at that time was approximately equidistant from the Virginia Capes and Sandy Hook, 240 miles off shore. During this time a constantly increasing list developed until the vessel sank. The cause of this list to begin with does not seem to be clearly established. Finally this condition, it is thought, was aggravated by the shifting of cargo.

The consensus of the testimony taken at an investigation into the sinking of the ship conducted by United States Attorney C. H. Tuttle before United States Commissioner Francis O'Neill at New York indicates that the VESTRIS was shipping water through a coal port and through so-called half ports in her starboard side as she rolled and wallowed helplessly in the heavy seas. Some testimony also points to her taking water through the lower port lights and through the ash ejector pipe and connections in the stoke hole. Whatever the original cause of her list, whether shifting of cargo or the shipping of water, her stability due to this list which could not be corrected had been so seriously impaired that she was doomed. In addition to her passengers and crew the VESTRIS carried a general cargo of 6000 tons including automobiles, machinery and 1097 sacks of mail.

Hearings are now being held by American authorities. A thorough investigation will of course, be made by the British board of trade. When

these inquiries have been completed and all the testimony has been carefully analyzed by competent scientific and practical authorities the real facts in this case will be clearly established. It will then be possible to draw definite lessons from this disaster and to emphasize measures and precautions to be taken to prevent a recurrence.

It is, however, possible without unfairness to those involved to speculate perhaps with some profit on certain outstanding features. Prior to sailing, on Nov. 7, the VESTRIS was drydocked and underwent the periodical four-year survey by Lloyd's register of shipping. This is considered a very thorough examination for seaworthiness, including hull plating, pumps, watertight doors, double bottom and watertightness of ballast tanks. The vessel at that time was also subjected to the usual United States steamboat inspection pertaining to general seaworthiness and particularly to determine that all kinds of life saving equipment was in first class condition and that it met the requirements of the rules and regulations in regard to foreign passenger carrying vessels clearing from an American port. The United States inspectors found the ship satisfactory in every respect and the usual certificate, dated Nov. 7, 1928, was issued to the VESTRIS.

When the emergency came, however, it appeared, as indicated from a consensus of the testimony already heard, that there were failures both in the human element and in mechanical equipment. It is clearly apparent now that Captain Carey failed in judgment in delaying so long the sending of an SOS. But he went down with his ship and maintained the traditions.

Other questions arise. Why, having sent out an SOS were not orders given to take to the boats sooner? It is likely that the reason was, that the captain at this time was hoping and believed that his vessel might be kept afloat until the arrival of aid. He was reluctant to take a chance not only in the successful launching of the lifeboats but in their weathering the high seas running. This again was a mistake of judgment as it worked out.

Co-operation in an Emergency

Again, still other questions will naturally arise in regard to the apparent unsailor-like execution of the order to abandon ship. It must be borne in mind that the ship had a list of 32 degrees or more at this time and that the seas were still running high, and that the launching of lifeboats under such conditions was an extremely difficult task.

The human element again, as always, is found to be subject to failure when an emergency arises. It is therefore of the utmost importance as a measure of safety to emphasize again and again the need of perfecting the co-operative action of the entire ship's personnel. Conditions attending the launching of lifeboats on the VESTRIS and the chances of saving all passengers, we believe, would have been much better had the ship's organization functioned in a thoroughly well trained manner. It is obvious of course, that passengers should be assigned to lifeboats and that each officer and man on board should have his definite station and his duties clearly defined in case of emergency.

Greater Safety in Ship Design

On the shore end of inspection everyone acquainted with conditions as they exist knows that due to repetition and familiarity such inspections are apt to become cursory and lacking in thoroughness. It takes a disaster to again bring out such a natural human tendency. It is certain, however, that all inspections of vessels particularly those asking for passenger certificates should be very thoroughly carried on in all those principal features which establish seaworthiness and proper functioning of all lifesaving equipment in an emergency. For instance, now that it is possible to look back, the inspection of all ports in the side of the ship and of the ship's hull throughout should be of major importance. It should be definitely determined that all of the lifeboats and the mechanical gear for launching them are in good condition and first class working order. In view of the disaster it can now be said that this cannot be determined by merely visual inspection. It is necessary and it would be practicable in an inspection of this kind to actually go through all of the initial steps in launching each lifeboat. It would of course, be troublesome and annoying to those operating the ship, but the price of safety, as of liberty, surely depends on eternal vigilance.

So much for a discussion of doing things somewhat better under conditions as they exist. Looking to the future the sinking of the VESTRIS should serve as a very serious lesson in furthering the objects of the convention for safety of life at sea which is to convene in London next April.

In looking to the future, scientific and practical men should agree and their governments should support them in promulgating and enforcing certain fixed principles in the design and construction of all passenger ships. This would not mean any interference with individual initiative in the design and development of ships to serve particular purposes. It would merely bring the high knowledge of the scientific and practical world to bear with its great value in making safe, every passenger vessel. All intelligent right-minded men the world over can agree on such a program and if the sinking of the VESTRIS helps to bring about such an agreement, the lives lost will not have been lost in vain.

Need Strong Navy

(*Continued from Page* 19)

naval ratio adopted for capital ships was intended to apply to all types of combatant ships. What has been done since the Washington arms conference toward carrying this idea into practical effect?

The records disclose that the naval building activities of the Washington treaty nations for vessels laid down or appropriated for, contracted for, built and building, credit the British empire with 55 vessels of 335,769 tons; Japan 127 vessels of 401,361 tons; France 120 vessels of 291,785 tons; Italy 71 vessels of 151,374 tons; and the United States with 19 vessels of 157,790 tons.

The United States scrapped approximately 850,000 tons of naval vessels, among them some of our most modern naval craft. This scrapping program cost our nation close to 400 million dollars. Incidentally had these vessels been completed America would have attained world naval supremacy. America, however, acquiesced in the scrapping of these vessels in the hope that this sacrifice would prevent further naval competition, thereby assisting other nations by the curtailment of their naval expenditures to divert these funds to the restoration of these nations to their normal peace-time activities.

No Longer on a Parity

From the figures disclosed by the building activities there seems to have been no let-up in the building of other than the capital ships specifically limited by the treaty. This means that we are not on a parity with Great Britain in naval strength as was originally intended, and that with respect to other nations the United States has dropped considerably below the ratio agreed to in principle at the Washington arms conference.

When the Geneva arms conference was called, two of the nations parties to the Washington conference did not participate. The purpose of this conference was to definitely carry into effect the principle and spirit contained in the United States naval policy based on the Washington treaty for the limitation of naval armament, to definitely apply the ratio now existing for capital ships to other types of combatant vessels.

At the Geneva conference we had nothing to give, the other nations did. If the spirit manifested at the Washington arms conference had been adhered to there would have been no need for the Geneva conference. The deliberations at the Geneva conference centered on the cruiser situation, the arming of merchant vessels, and the protection of trade routes.

The conference ended in a deadlock and were it not for the fact that the question of merchant ships was so prominently brought into the picture the Geneva conference would have been recognized as a complete failure. As it was, the recognition by the conference of the vital importance of merchant vessels as an indispensable factor toward naval strength must obviously be regarded as a constructive measure. In this light our weakness was very forcibly revealed to the American people.

The records show that since the completion of the war-time shipbuilding program, not one ship has been constructed in American shipyards for the overseas foreign trade and that we have been outbuilt in modern competitive types of ships by all our trade competitors.

During the period 1922-1927, covering ships of 2000 gross tons and over for transoceanic service we find that out a total of 1300 ships, of approximately eight million gross tons, the United States is credited with 18 ships of less than 200,000 gross tons, thus being outbuilt by Great Britain by almost 50 to 1; Germany more than 10 to 1; France more than 5 to 1; Italy almost 5 to 1; and Japan more than 4 to 1.

It is inconceivable that the costly experience in depending on ships of our competitors to move our commerce and the lack of merchant vessels to serve as naval auxiliaries should be so soon forgotten. To produce ships during abnormal times is a costly procedure. It cost the nation for the last experience three thousand millions.

The vital fact is that since the Washington arms conference not only have our competitors made great gains in their naval building activities but they have left us far behind in the building of merchant tonnage. We must not lose sight of the fact that the sea strength of a nation consists of the combined strength of its naval and merchant vessels and during hostilities they reflect the real sea power, each serving the other. Therefore, when we speak of naval ratios and naval equality, unless we take into consideration both our naval and merchant vessels as a basis to establish ratios, the comparative naval strengths have little or no significance.

Shipbuilding at Low Ebb

Our country is credited with less than 3 per cent of the shipbuilding activities throughout the world. This has resulted in the present deplorable situation in our shipbuilding industry. Not only have we permitted our competitors to outbuild us in both naval and merchant tonnage, but we have permitted so important an industry as our shipbuilding to decline, which places us, from a standpoint of national defense, in a still further untenable position.

The time has arrived when we should no longer permit the advice and dictates of pacifists and foreign propagandists to influence us in establishing our commercial independence and in providing for national security commensurate with our position as a first-class commercial and maritime nation.

The so called Washington conference is a favorite theme of those who in heart would abandon all the naval vessels we have and never build others in their stead. Just what did the conference do and what is its outcome as of today?

It is axiomatic that we agreed on the premise that actuated the United States in calling the conference of the limitation of armament at Washington in 1921-1922, to understand the viewpoint of thinking Americans of today.

Its object was to lift the demands of competition in naval armament and release the enormous sums involved to aid the progress of civilization and particularly to aid in the restoration of the war torn nations to normal peace time pursuits. The primary intent of the conference, subscribed and agreed to by its participants, was to

(*Continued on Page* 62)

The author of this article, Alfred H. Haag, is director of the Department of International Shipping, Georgetown University School of Foreign Service.

Attains Record Speed

THE United States airplane carrier LEXINGTON *has the proud record of being the fastest and the highest powered large ship, merchant or naval, in the world. This record was established on Nov. 15, when during official trials, according to report, she made an estimated speed of 34.5 knots and developed 210,000 horsepower. Like other modern American naval ships the* LEXINGTON *is fitted with turbine electric drive. There are four propellers, each one driven by two electric motors developing together 45,000 horsepower, or 180,000 horsepower for all four propellers. During the trials referred to above the* LEXINGTON *therefore developed more than 16 per cent over maximum requirements. She was built by the Fore River plant of the Bethlehem Shipbuilding Corp. and her turbine electric machinery was supplied by General Electric Co.*

Shipbuilding Revival is Assured As Naval Architects Meet

EVERYONE attending the thirty-sixth annual meeting of the Society of Naval Architects and Marine Engineers at New York, Nov. 15 and 16 could not help but be impressed with the great interest shown in the reading and discussion of technical papers. Also it is clearly evident that there is a distinct revival of hope, based on recent developments, that the American merchant marine has finally reached the beginning of an epoch of expansion and prosperity. Homer L. Ferguson, president of the society presided. A considerable number of new members and associates were elected.

Looking over the two days reading of papers two interesting facts stand out. First, the evidence of much work done and great interest shown in the possibilities of improving methods of burning coal; second, the tremendous advance made toward general acceptance of that distinctly American marine engineering development, the electric drive. But aside from these two main major currents of interest much discussion was aroused in connection with every other paper with the possible exception of the paper on the design of a flying boat where the audience generally did not feel competent to enter into a discussion.

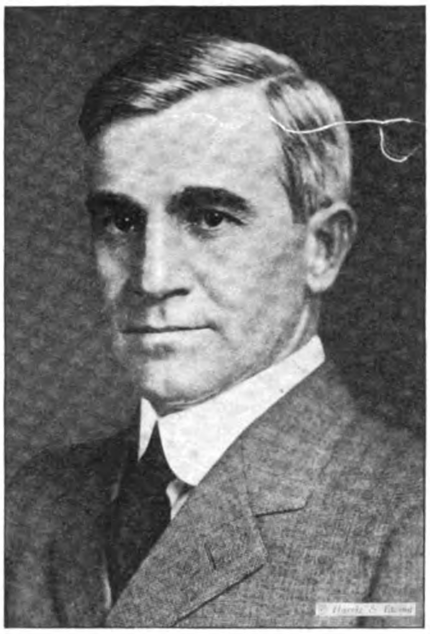
Never before in the writer's recollection has there been shown a more lively appreciation of the progress being made in marine engineering and naval architecture. In several instances the chairman was compelled to cut short very interesting discussions in order to go on with the next paper to be presented. All of the professional meetings were exceptionally well attended. The meetings opened with the annual address of the president, as follows:

President's Annual Address

The year drawing to a close has been momentous in the shipbuilding industry. Accomplishments have been substantial, but it is the dawning of a new era in shipbuilding in America that sets this year apart from the lean years of the past.

Outstanding among the events which have marked this year is the passage of the Jones-White act. This legislation with its favorable loan provisions and its mail subventions is too well known among the membership of this society to be discussed at length at this time. Years of effort on the part of those who have seen the vital need of this legislation have at last borne fruit in an almost nation-wide realization of our merchant marine as an essential factor in our foreign trade and national defense.

It is especially gratifying to us as shipbuilders and members of the professions of naval architecture and marine engineering that the incoming chief executive of the nation has



Homer L. Ferguson
President, Naval Architects & Marine Engineers

given this policy his hearty endorsement. In his speech at Boston a month ago Mr. Hoover stated: "The hope of a substantial merchant marine lies ultimately in the new character of overseas shipping, in the energy and initiative of our citizens with assistance and co-operation of the government. That assistance and co-operation is now being given and must be continued."

Although there have been several notable additions to the American merchant marine during the year, the volume of work in the shipyards has been pitifully small. The outlook, however, under the Jones-White act is encouraging. Many important mail contracts have been awarded and the shipping board has received a number of applications for loans with which to finance new construction. Plans and specifications for 20 new vessels have already been completed and designs for 22 more are in various stages of development. These vessels are generally of the passenger and cargo type, some of them of considerable size, and all thoroughly modern in design. In addition to the new construction contemplated, reconditioning and modernizing of several large vessels is under consideration and work is actively starting on a continuation of the shipping board conversion program, contracts having recently been placed with shipbuilders for converting eight steamers of 9300 tons deadweight into up-to-date motorships.

In reviewing the closing year, it is necessary to record an unfortunate event, not only for shipbuilders but for the nation as a whole, in the failure of the senate to act upon the bill embodying the administration naval building program. After our act of immolation in 1921 when new American fighting ships were scrapped and old ones retained, it became the imperative duty of those charged with the nation's defense to maintain our reduced navy at the peak of efficiency and the failure to provide the units necessary to round out the fleet into an effective and co-ordinated fighting machine is nothing less than blind and dangerous folly. Paper ships have never prevented war nor repelled an enemy.

Turning now to the developments and trends in the shipbuilding art which have marked the year 1928, a brief resume of the outstanding features might be of interest. I shall not attempt a detailed discussion of these developments as many of them are covered in the papers which follow.

New Standards of Speed

We are standing today at the dawn of a new era in overseas transportation and it is not surprising that American shipowners and builders should endeavor to be in the forefront when new standards of speed are being projected both in passenger travel and transportation of goods. Spurred on by keen competition, ship-

builders abroad have been building cargo ships with a service speed of 14 to 15 knots, made possible largely through efficient propelling machinery. American owners, with government co-operation, will not fall behind and the day is not far distant when the "express cargo liner" will have its place in the American merchant marine. Mr. Hoover has caught the vision of the present age in pointing out the need for "regular, ferry-like service of large cargo liner ships."

The spectacular and ambitious proposal to step up the speed of travel in the North Atlantic seven knots or more, by the building of a great fleet of four-day liners has met with keen interest on the part of both the public and marine engineers and naval architects. Despite the unfavorable report of the shipping board, the economic and engineering phases of this giant undertaking are being carefully worked out by experts and we may expect further developments in this proposition.

The continued progress of the marine diesel engine with its low fuel consumption has stirred designers and manufacturers of the various units of steam propulsion to new efforts to improve the economy of their machinery. Profiting by the experience in central power stations ashore, these efforts have been directed largely toward making higher steam pressures and temperatures practicable on shipboard. One large American vessel has entered service during the year with a steam pressure of 350 pounds and 200 degrees Fahr. superheat and another larger vessel will be completed this month with boilers generating steam at 300 pounds and 200 degrees Fahr. superheat, while practically all of the large vessels now projected with steam machinery will employ pressures and temperatures in this range or higher.

Electric Drive to the Fore

During the year, electric drive has further demonstrated its advantages in the field of large fast passenger and freight ships. The successful operation of the Panama-Pacific steamship CALIFORNIA to be followed next month by the steamship VIRGINIA, has led the International Mercantile Marine Co. to install this same type of machinery in its third ship of this class now under construction. Electric propelling machinery will be fitted also on a large passenger liner to run between New York and the west coast of South America, the contract for which has recently been placed.

The modernization of existing tonnage has also been a feature of 1928. Several large ships have re-entered service with modernized passenger accommodations, work on others is under way, and similar work is contemplated on a number of others, including, perhaps, the ex-German liners now known as the MOUNT VERNON and MONTICELLO.

Outstanding in this work of modernization is, of course, the shipping board's diesel conversion program, the continuation of which is now going ahead on eight vessels. We will hear during this meeting of the performance of the first 12 motorships completed under this program.

In line with the shipping board's policy which has resulted in the valuable experience gained in the construction and operation of these motorships, and in the use of pulverized fuel on the steamship MERCER, other experiments might be made by the board with great profit to American shipbuilders and shipowners in high pressure steam machinery and in combination reciprocating engine and low pressure turbine installations, which latter type of propulsion especially seems to offer further possibilities in the utilization of some of the government's idle fleet.

Improve on Past Standards

There has been a steadily growing tendency in recent years, especially marked in 1928 during which plans have been formulated for the construction of so many first class ships, to improve upon past standards, not only along structural and engineering lines, but to an equally great extent in matters which have to do with safety of life, handling, protection and preservation of cargo, aids to navigation and the comfort, service and entertainment of passengers. There is almost as much difference in these respects between the first-class American passenger and freight ships of the kind being designed and built today and the ships of a few years back as between these ships and the famous BRITTANIA, on which Charles Dickens crossing the Atlantic in 1842 described his stateroom as an "utterly impracticable, thoroughly hopeless and profoundly preposterous box," and the dining saloon as "a long narrow apartment, not unlike a gigantic hearse with windows in the sides." On the passenger ships of the present era in matters of comfort, service and beauty the traveler finds the same standards, often even better, as in the first-class hotels of the larger cities and in addition enjoys the fresh sea air and freedom from the fumes and noise of city streets.

In spite of the substantial cost reductions which shipbuilders have been enabled to make, such improvement in the conditions of travel at sea has not, of course, been brought about without an increase in the cost of building the ships. The owner who expects to build a first-class ship today at the same price as was paid for previous ships even five years ago, is either doomed to disappointment, or if his expectation is realized the ship will contain not a few items for which the shipyard has received no pay at all. One of the things which effects the cost disproportionately is the fact that the owners' naval architect has a distinct tendency to provide a design which is more elaborate than the particular service demands, or which fails to take advantage of the cheapest way of accomplishing the desired result, or which is so described that some of the estimators are left in doubt as to what the cost is going to be.

Navy Yard Competition

Moreover, cost is materially affected by volume, and unless the shipyards are kept full of work, the cost of any particular vessel is higher than it would otherwise be, even though this increase in cost, due to excessive competition, may not show in the price. The excessive competition to which I refer is not merely that between commercial shipyards, but includes the navy yards, which, unfortunately, according to many in congress, must be kept busy building ships even though the shipyards are put out of business due to lack of work.

Shipbuilding along industrial lines has kept pace with the developments in design and engineering. Chief among the newer methods which have helped the builder, and to the development of which the year 1928 has contributed substantially, is electric arc welding. Impetus has been given to this process by its extensive use, largely as a means of saving weight without sacrifice of strength, on the scout cruisers now under construction. Completely welded barges are now being built, welded fittings as well as structural members are extensively used, and the day is not far distant when welding bids fair largely to replace riveting as a means of assembling ships, both large and small.

Another line along which a start at least has been made and which seems to offer inviting possibilities in the way of improving the quality of work aboard ship with a reduction in both operation and construction costs is that of finishing wood and metal surfaces. Lacquers have found

an enormous field in the past five years in the automobile industry and aluminum paint is being tried extensively in factory buildings and on steel work. Its use on the scout cruisers under conditions at sea will furnish shipbuilders and shipowners valuable information. The successful use of these new processes in work ashore will certainly be followed shortly by their general application to the marine field.

Modern Management Methods

And last, but by no means least, among the developments of the year in the shipbuilding industry has been the wider application of modern management methods. Two factors alone have saved the shipyards thousands of dollars during the past year; one of these has been an intensive campaign to eliminate waste, a war waged as earnestly by workmen as by supervisors; and the other a safety campaign which has reduced accidents to a new low level. This is too broad and tempting a field to venture far into at this time, but before bringing this review of American shipbuilding in 1928 to a close, I should like at least to name for you the management factors which we in our plant have found to offer great possibilities in reducing the costs of building ships, and these are:

Complete control of materials.

Budgeting of shop expense and direct labor.

An incentive system for every worker.

Planning and scheduling.

Lower costs to the shipbuilder mean lower prices to the ship owner; price is the serious handicap under which shipbuilding in the United States suffers, and to the lowering of which all naval architects and marine engineers should bend their best energies.

We have just received news of the tragic sinking of the VESTRIS with a sad loss of life which would undoubtedly have been greater but for wireless. This disaster will serve to stimulate the efforts of the second convention on safety of life at sea to be held in London next April. The United States will be represented there by a delegation, some of whom will be members of this society.

Technical Papers Presented

Thirteen papers were presented during the two days' meetings. These papers and the discussions will be published in full in volume 36 of the transactions of the society which will be ready in early summer next year. The titles and the names of authors of these papers and brief abstracts are given herewith.

1. *The Scientific Application of Welding to Ship Construction*, by James W. Owens, visitor.

The author is undoubtedly one of the leading practical and scientific students of the art of welding in the United States. He is now and has been for some time the director of welding at the Newport News Shipbuilding and Dry Dock Co. His paper is an authoritative and exhaustive treatise on the progress made in the use of welding in ship construction. He traces the history of and differentiates between various welding processes. The advantages of welding in the saving of weight and cost is pointed out. Also the possibility of actually obtaining better work. Mr. Owens also covers the principles of welded design. He shows by many illustrations the features of such design. He pointed out that the primary reason for permitting extensive use of welding on the coast guard cutter, NORTHLAND was to obtain a stronger ship than one entirely riveted. In this vessel was made the most extensive application of welding to ship construction heretofore ever attempted in the United States. This vessel was launched Feb. 5, 1927 and is in service in the Arctic ice floes north of Alaska and Siberia. She has already weathered several bad gales and no welded joints have failed. Welding was also used at the Newport News shipyard quite extensively on the CALIFORNIA, VIRGINIA, and the Baker yacht. This paper was received with great interest and developed an interesting discussion which brought out further progress made in the application of welding.

2. *Recent Developments in Shipbuilding on the Great Lakes*, by A. W. Cross, member.

The author has been naval architect for the American Ship Building Co., the largest shipyard on the Great Lakes, for many years and is therefore well qualified to present this very interesting paper. The text of it is comparatively brief. It is pointed out that the present types of vessels operating on the Great Lakes have been developed to meet the limitations of nature. The principal commodity carried by lake vessels is iron ore and the return voyage is made in ballast or with coal. Grain is also moved.

A brief general description is then given of the latest and most modern bulk cargo vessel, the steamer, HARRY COULBY. Many illustrations are shown; also complete cross section and certain structural features; deck plans, outboard profile, main engine and machinery layout. A complete account of this interesting vessel was published through the courtesy of Messrs. Cross and Workman of the American Ship Building Co., in the October 1927 number of MARINE REVIEW.

To top off this interesting paper the author through the courtesy of the bureau of mines presented a short moving picture showing lake vessels loading iron ore at Duluth, passing through the Soo locks and unloading at Lake Erie ports. This most interesting, actual demonstration of the service of a typical Great Lakes freighter was received with the greatest interest by all those present.

Henry Penton, consulting marine engineer recognized as an authority on the design and service of Great Lakes vessels contributed an important written discussion supplementing Mr. Cross' paper. His discussion is published elsewhere in this issue.

3. *Some Observations on the Design of Airplane Carriers and Notes on the Saratoga and Lexington* by Rear Admiral George H. Rock, C.C. U.S.N., member.

This paper covers in a concise manner important data on airplane carrier design and particularly the SARATOGA and LEXINGTON. The advantages of various features of design are stated. There is also published a summary of the trial data of the U.S.S. SARATOGA. There is also given the very interesting standardization curves of horsepower on speed and revolutions on speed and revolutions per minute on shaft horsepower.

4. *Design of a Large Flying Boat*, by Capt. Holden C. Richardson, C.C. U.S.N., member.

Perhaps no constructor in the navy has had so long or so intimate a contact with the development of the hydroplane and flying boat as Captain Richardson. He was responsible for the design of the early pontoon for flying craft. His paper covers the determination of form and loading conditions met with in a large flying boat now under construction for the navy yard. Calculated performances based on model basin and wind tunnel data are also given. The plane described is a monoplane with twin engines, triple float, patrol type of plane of all metal construction except the wing covering and covering of tail surfaces. It is being built by the Consolidated Air Craft Corp., Buffalo.

The author shows a very interesting set of lines and also curves of speed and resistance. Other fig-

ures have been plotted for floating loads and hogging conditions. Capt. Emory S. Land, naval constructor, prominently identified with the navy's aeronautic activities presented the paper in the absence of the author. He also pointed out to the society that the problem covered in Captain Richardson's paper was directly in the line of the naval architect. Also that the design of craft of this type in Europe was far ahead of this country.

5. *The Inclining Experiment*, by Rear Admiral John G. Tawresey, C.C. U.S.N., retired, member.

Admiral Tawresey in presenting this paper performed a very valuable service to the profession of naval architecture. He clarified and brought up to date an old and well known experiment. He has emphasized the practical side of the problem, detailing throughout what he has found from practice to be the best. Anyone faced with the responsibility of performing an inclining experiment will find valuable assistance in Admiral Tawresey's excellent paper. The discussion following the presentation of the paper was animated and interesting. Various practical experiences in conducting inclining experiments were presented and add to the value of the paper.

6. *Propeller Backing Power in Tugboats*, by Alfred J. C. Robertson, member.

Mr. Robertson as naval architect with the Fairbanks, Morse Co. is bringing a very useful point of view to the engine builder. His paper on the backing power in tugboats is exactly along this line. It is a valuable attempt to solve some of the difficult questions propounded by the customer. As the author points out, very little has been published on the backing power of the screw propeller. The experiments were carried out at the model basin, Washington. The model with which the experiments were conducted was taken to represent a tugboat of 110 feet in length by 23 feet 4½ inches beam and a mean draft of 6 feet 9 inches.

Many interesting curves of valuable data are published with the paper. The author comes to the conclusion that it is apparent from the tests that it is quite impossible for a tugboat with a single screw to develop an efficiency going astern equal to that of going ahead, a requirement, which, as he says, is not infrequently specified. A number of favorable comments and some discussion followed this paper.

7. *Development of Pulverized Fuel for Marine Purposes During* 1927-1928, by Carl J. Jefferson, member; Commander Joseph S. Evans, U.S.N., and Commander Joseph Broshek, U.S.N. visitors.

The authors of this paper particularly, Mr. Jefferson and Commander Evans have been intimately connected with the excellent work carried out over the past two years by the fuel conservation committee of the shipping board and the fuel testing plant at the League Island navy yard, Philadelphia. On the strength of their work an important paper was presented at the meeting of the society a year ago on the results obtained burning pulverized coal in a standard, three furnace separate combustion chamber, scotch marine boiler.

The paper deals with a brief description of the pulverized coal burning equipment on the S. S. MERCER. This vessel was converted to burn pulverized fuel at the Maryland Dry Dock & Shipbuilding Co., October 1927. An account is given at some length of the first voyage of the MERCER operated as a pulverized coal burner. In this account the economic features of comparative fuel costs and crew wages are discussed. Such questions as ash deposits and mechanical troubles developed are mentioned. An analysis is given of the sea performance of the pulverizer. Brief accounts are also given of the MERCER voyages, 2, 3, 4 and 5. After a year's operating service of the MERCER the authors are able to point to several salient points that must be taken care of to make a satisfactory installation of pulverized fuel in scotch marine boilers. These points are summarized as follows:

A. Considerably finer pulverization of fuel is required, than that necessary with large refractory lined furnaces such as found in shore plants.

B. High turbulence of flame is required to produce complete and rapid combustion necessary in the comparatively short flame travel of a scotch boiler.

C. Consistently uniform distribution of fuel between various furnaces of the scotch boiler is necessary for efficient performance.

D. The power plant for producing pulverized fuel must be of an economical type which may be secured either by installation of efficient low water rate units or by useful employment of exhaust if less efficient units be used.

E. Extra precaution must be taken to secure dust tight smoke box doors and uptakes, otherwise when using soot blowers it will be impossible to maintain a satisfactory fire room condition.

F. The velocity of coal stream throughout cycle requires special consideration to prevent overloading of fans and coal precipitation in pipe lines and to secure satisfactory selection of superfine grind from mill and turbulence at burner.

G. Personnel must be trained to give the same close supervision to velocity as is required in regard to viscosity and pressures when using fuel oil.

H. The usual fire room instruments, such as orsat and pyrometer, are important but of greater importance are the draft gage and smoke indicators.

I. Sized coal of 100 per cent slack coal gives more uniform operating conditions than will run-of-mine; in fact, bunkering with run-of-mine will require use of crushers to produce fuel having a limited maximum size, otherwise feed to mill will be very irregular, a condition that will be reflected throughout the whole operation of the boiler plant.

Two other installations, those on the S. S. LINGAN and the S. S. STUARTSTAR are briefly described. It is stated that the reliability and the safety of pulverized fuel have been thoroughly demonstrated by actual sea operation of the three seagoing installations cited, also by the performances of the towboat ILLINOIS which has been in operation approximately 18 months on the Mississippi river. It has also been demonstrated that certain fuels which could not be used otherwise in a scotch marine boiler can be satisfactorily burned with the pulverized system. Furthermore the economic possibilities have been indicated and the problem in relation to adapting pulverized fuel in marine practice has been crystallized. Definite progress has been accomplished but the final standard type of installation still needs to be worked out. Conversions and new installations now being made will further the development of the art and aid toward transforming it from an art into a fixed science having definite laws that can be employed with confidence by marine engineers.

The paper continues giving some important facts on distribution, different types of mills and other equipment of a pulverized coal burning system. Something is also said concerning the fineness of the coal. A brief description with illustrations is given of the new Todd system of pulverized coal burning for scotch boilers. The paper stated that this equipment was then under test and complete data was not available but that preliminary results had been very satisfactory. Elsewhere in this

issue appears an account of the final tests of this burner. The paper contains numerous drawings and illustrations pertaining to pulverized coal burning on board ship. There is also a reproduction of a voyage report on the S. S. MERCER.

This paper was received with great interest and with appreciation of the valuable work done by its authors in original research and practical development in the art of fuel burning. Many favorable comments were made and much discussion ensued. A good deal of this discussion centered on marked differences of opinion as to the necessary fineness of the coal. Also something on the relative merits of different types of mills. The impression remained that it was of utmost importance to have the coal very fine for successful operation.

8. *The Burning of Hydro Carbons Under Marine Boilers*, by Ernest H. Peabody, member.

This paper was presented by a man known for many years as an authority on the burning of fuel under marine boilers. The paper reviews and brings up to date the general subject. One point which rather stands out is the discussion of the matter of necessary fineness and also the standardization of tests to determine fineness of pulverized coal. The paper is of interest in summarizing many of the steps leading to the present development. There are also some very fine illustrations of the appearance of a flame in burning fuel in marine boilers. Some discussion followed on fineness of coal and types of mills.

9. *Forced Blast Chain Grate Stoker Tests of a Marine Tube Boiler*, by Thomas B. Stillman, member.

For some time the Babcock & Wilcox Co. have been carrying on full sized practical tests with a forced blast chain grate stoker under the same marine water tube boiler on which previously tests had been conducted for burning pulverized coal. As the author said the object of both of these tests is the same; that is to develop methods for satisfactorily and efficiently utilizing coal as a fuel under marine water tube boilers and eliminating the heavy manual labor involved in hand firing. The forced blast chain grate stoker tested was designed by the Babcock & Wilcox Co. engineers and it was built at the Barberton, O. works of that company. It is essentially similar to the larger stokers of the same type manufactured for stationary purposes. Four blast compartments are used and individual damper control is provided between each compartment and the forced blast duct leading from the fan. This makes possible suitable control of the blast in each part of the stoker. The driving links of the stoker are made of steel forgings while the intermediate links between the driving links are iron castings. A motor of 1½ horsepower through a suitable reduction speed drive was used to move the chain grate at the rate desired.

A series of tests was conducted during July and September. In the paper a complete tabulation of these tests is given. There are also given analyses of the two types of coals used. The boiler efficiency and heat balances were carefully worked out. The coal and water were accurately weighed on calibrated scales and all pressures and temperatures were taken with calibrated instruments.

The boiler efficiencies compare favorably with what is regarded as good stationary practice where no air heaters or economizers are employed. Rates as high as 147,000 B.t.u. per cubic foot were secured with boiler efficiencies in excess of 75 per cent. It is interesting to note that the author points out that the boiler efficiencies secured with the forced blast chain grate stoker averaged between two and three per cent less than the efficiencies secured on the same boiler burning pulverized coal. In overall efficiency however the stoker will be at least equal to and probably more efficient than pulverized coal. Compared to average hand fired installation the overall efficiency of the forced blast chain grate stoker equipped ship will be at least 10 per cent better, which means in this case a direct saving of 10 per cent in the annual coal consumption.

It is remarked that a wide variety of coals may be burned efficiently on this type of stoker. Less than one horsepower per boiler is required to operate the stoker. The flexibility of the chain grate stoker installation is the same as for hand firing. Ashes may be readily disposed of by the use of suitable equipment with no manual labor. By the installation of such a stoker on shipboard and taking into account not only the increased thermal efficiency but the reduction in personnel an appreciable saving in the cost of operating the ship may be made as compared with hand firing.

10. *Turbine Electric Drive as Applied on the Great Lakes Cargo Ships*, by C. R. Fisher, visitor, and A. Kennedy Jr., member. Printed in full elsewhere in this issue.

11. *The Central Power Station Goes to Sea*, by Commander Quincy B. Newman, U.S.C.G., member.

This paper was clearly and effectively presented by the author. It represents a very convincing summary of the final excellent engineering achievements attained by the engineering staff of the United States coast guard. The paper describes in considerable detail general characteristics and machinery of the recently completed turbine electric coast guard cutter PONTCHARTRAIN. Comparisons are made between these results and those obtained for the coast guard cutter, MODOC contained in a paper presented by the author to the society five years ago. The principal object of the trials of the PONTCHARTRAIN, the author states, was to determine whether the boilers and propelling machinery met the performances guaranteed by their builders. The trials were conducted by four interested parties, Fore River plant of the Bethlehem Shipbuilding Corp., builder of the ship; Westinghouse Electric & Mfg. Co., builder of the machinery; Babcock & Wilcox Co., builder of the boilers; and the coast guard, owner and operator. The trials were conducted at sea off the port of Boston, Sept. 13 and 14 and the standardization runs were made on the Providencetown course.

Tables giving a comparison between the MODOC and PONTCHARTRAIN indicate a decided superiority for the latter. Under certain conditions for instance the PONTCHARTRAIN used 0.84 pound of oil per shaft horsepower per hour for all purposes while the MODOC under comparable conditions used 1.195 pounds. These trials were carefully conducted and the results were carefully noted. The figures presented by Commander Newman are of very definite value to all shipping men interested in the development of the best engineering practice for ship work. Much favorable comment and interesting discussion followed the presentation of the paper.

12. *Description and Trials of the California*, by Capt. Roger Williams, member.

So much interest had been aroused by the presentation of the two preceding papers that the chairman, Capt. W. M. McFarland was forced to stop the discussion, which he did by a vote of the audience, in order to allow time for the presentation of Captain Williams' valuable paper. The performance of this first large turbine electric merchant ship has been watched with great interest. The results as indicated in this paper have been highly satisfactory in every respect. This vessel is efficient from an engineering point of view with a fuel consumption of 0.78 pound per

shaft horsepower per hour for all purposes. And in service she has proved herself able and seaworthy. Captain Williams remarked that she had come through the same severe gale that brought disaster to the VESTRIS, without the slightest damage to herself or injury to any passenger. She has proven in service to be a steady, vibrationless and remarkably comfortable ship. The paper gives a general description of the vessel and particulars concerning the first and second voyages. Performance data are given in detail. There are also numerous splendid illustrations of exteriors and interiors, including the machinery spaces.

13. *Performance of the Converted Motor Vessels of the United States Shipping Board*, by Capt. Richard D. Gatewood, C.C. U.S.N., member.

Every shipping man is interested in any effort to reduce the cost of ship operation. It was with this object in view that the shipping board several years ago called for the dieselization of twelve freighters then fitted with steam machinery. Last year Captain Gatewood, then as now, in charge of maintenance and repair for the Emergency Fleet Corp. presented to the society a paper detailing the work done in converting this fleet of twelve vessels to diesel drive. The paper this year gives information in detail as to the actual performance in service of these twelve diesel vessels. It is a very valuable and interesting paper.

In his conclusion the author points out that the twelve vessels of the initial phase of the shipping board's diesel conversion program had traveled a total distance of 545,852 miles of which there is recorded data. Although mechanical difficulties have been experienced they are such as would normally be expected in an extensive program of this nature, purely pioneering and experimental to a certain extent. It was stated in the paper that the difficulties that have been experienced are not insurmountable, and although it is reasonable to expect more in the future the success that has attended their performance to date has clearly demonstrated that American manufacturers can build a satisfactory and reliable marine diesel engine in the larger sizes suitable for ocean going vessels.

This paper was received with keen interest and the steam men were not kind in their pointed remarks at the diesel engine based on this report made by Captain Gatewood. However, the diesel engine stood its ground in good shape. It was defended in a very sensible and eloquent plea by no less an engineer than Elmer A. Sperry. It was also ably defended by the author of the paper.

The Election of Officers

At a meeting of the council of the society the results of the election of officers was officially determined. Francis L. duBosque becomes honorary vice president and John Halligan Jr. succeeds him as vice president for the term expiring Dec. 31, 1929. J. Howland Gardner, Richard M. Watt, Charles P. Wetherbee and Herbert C. Sadler were elected vice presidents with terms expiring Dec. 31, 1931. The council members representing members of the society with terms expiring Dec. 31, 1931, are Hugo P. Frear, Theodore E. Ferris, Frank M. Lewis, William W. Smith, Elmer A. Sperry and William L. R. Emmet. Council members representing members with terms expiring Dec. 31, 1929 are Henry Penton, vice H. C. Sadler, John F. Metten, vice H. P. Norton, resigned; also William S. Newell, vice John Halligan Jr. term expiring Dec. 31, 1930. The council members representing associates with terms expiring Dec. 31, 1931 are, Paul H. Harwood, George D. Ali and Alfred G. Smith. The executive committee as now constituted includes Homer L. Ferguson, Washington L. Capps, Walter M. McFarland, Francis L. duBosque, Joseph W. Powell, J. Howland Gardner, Charles A. McAllister and Morris Douw Ferris. The committee on papers include Francis L. duBosque, J. Howland Gardner, Herbert L. Aldrich and William W. Smith. The secretary treasurer is Daniel H. Cox; and the assistant secretary treasurer is Thomas J. Kain.

The annual banquet was held on the evening of Nov. 16 at the Waldorf Astoria hotel. There was a large and enthusiastic attendance. The president of the society, Homer L. Ferguson presided. There were a number of interesting speakers including Gen. Herbert M. Lord, director of the bureau of the budget.

Detroit S. B. Co. Sold

River front property valued at $1,500,000, comprising 14 acres and including the plant and docks of the Detroit Shipbuilding Co., was sold to James S. Holden Co., Detroit real estate firm. This sale marks the disposal of the last Detroit unit of the American Ship Building Co. of Cleveland. The Biddle Ave. Realty Corp. made the sale for the American Ship Building Co.

Board Takes Action on Surplus Tonnage

Action to dispose of surplus tonnage not considered serviceable in its present condition was taken by the shipping board recently. The board issued instructions that 45 vessels of the submarine type be advertised for sale either for scrap, for conversion to diesel propulsion, for conversion to barges or for operation as steamers. Bids will be opened at the shipping board Dec. 11, 1928.

The vessels are of approximately 5000 deadweight tons each. They are laid up as follows: James River, 23 vessels; New York, 5 vessels; Philadelphia, 2 vessels; Mobile, Ala., 2 vessels; New Orleans, 5 vessels; Orange, Tex., 8 vessels. Sale of these vessels, if effected, will leave less than 450 vessels in the board's laid up fleets.

In the event any or all of the vessels are sold for conversion to motorships the contract of sale will require that the work be performed in American shipyards and that the engines installed be of American manufacture. This stipulation is in accordance with the shipping board's policy of encouraging development of diesel engine manufacture in this country. Bidders not contemplating purchase of the vessels for operation must agree to scrap them completely.

Use for Grain Storage

The shipping board on Nov. 22 granted an application of the Western Maryland railway for the use of a maximum of 20 cargo vessels now tied up in the James river for the purpose of storing grain at the port of Baltimore in order to relieve the serious situation which now confronts the railroads due to shortage of grain storage facilities. The vessels thus brought into service are not now in use for any other purpose. The period over which the charter arrangement will continue will be from six to 12 months, and it is specified that the number of vessels to be used will range from 5 to 20.

The charter hire for the first five vessels will be at the rate of $4500 per month. From the sixth to the tenth ship, inclusive, an additional $340 per month per ship will be paid. For the eleventh to the fifteenth ship, inclusive, an additional $280 per month per ship will be paid and for the sixteenth to the twentieth ship, inclusive, an additional $250 per month per ship will constitute the payment to the board. These vessels will provide considerable excellent grain storage space.

Turbine Electric Drive As Applied On Great Lakes Cargo Ships

By C. R. Fisher and A. Kennedy Jr.

THE cost of operating ships on the Great Lakes has very materially increased in the past ten or fifteen years, due primarily to increases in fixed charges, wages of crew and licensed officers, provisions and fuel. In an endeavor to meet these increased costs of operation the ship operators have built larger ships, endeavoring in this way to reduce the fixed charges, wages of crew and licensed officers, and provisions on a tonnage basis. There are practical limits in size of ships for a given service due to limited docking facilities, drafts, etc., and undoubtedly modifications will be made in the design of new ships as these various limitations change.

There have been some endeavors to decrease the cost of fuel, but until very recently such endeavors have been of a minor nature. Ships have been run at more economical speeds so as to reduce fuel costs, and some improvements have been made in the boiler and engine rooms. The economical speed of a ship depends to some extent on the economy of the prime mover. If the economical speed of a present Great Lakes reciprocating steam engine ship is 12 miles per hour, on this same basis some of the more economical forms of drive work out to be about 14 miles per hour; in other words, the increased earnings exceed the increased cost of fuel, allowing for delays, etc., with some of the more economical forms of drive, whereas with the present reciprocating steam engines the increased cost of fuel is greater than the increased revenue. Special conditions will, of course, modify any general statement, but this is undoubtedly true for ore carriers.

The reciprocating steam engine ship on the Great Lakes today takes between 1.65 and 2.25 pounds of coal per shaft horsepower hour for all purposes under a steady steaming condition. The coal used when the ship is delayed, checked, loading and unloading will materially increase the coal per shaft horsepower hour for all purposes.

The operating conditions on the Great Lakes are quite different from sea conditions. The average length of trip is relatively short; cargoes are often transported in one direction. Tugs are rarely used. The cost of coal when compared with the cost of diesel oil on a pound basis is something in the ratio of one to three; that is, slacked coal costs approximately two-tenths of a cent per pound, whereas diesel oil costs approximately six-tenths of a cent per pound. This is one reason why coal is used on the average Great Lakes cargo ship. There are special ships and services where oil can be economically used on the Great Lakes.

A Pioneer Justified

THIS paper is a most valuable contribution to the practical art of ship operation. A strange new drive has been adopted for the biggest vessel of her type in the world! A large sum of money has been expended on what many termed an hazardous experiment! The vessel begins operation! Will she be successful or will she be one of those dismal failures that not seldom are the results of too daring progress? The late Carl D. Bradley, responsible for the adoption of turbo electric drive lived to see his second vessel, named in his honor, hailed as a wonderful practical success. This paper is an account of the operating results obtained for this vessel during the period of her operation.

Departing for a moment from ship operation to central stations, we find that the cost of power generation has materially decreased in the past few years in spite of the increased cost of fuel. This has been accomplished by operators and manufacturers co-operating in the study of their problems. The manufacturers have expended large amounts of money in the development of more efficient means of converting fuel into power. Central stations have been able to deliver to their switchboard 1.25 horsepower hours for less than 1 pound of coal, or one horsepower hour for less than 0.80 pound of coal.

Certain of these modern and efficient means for converting fuel into power can economically be applied to Great Lakes ships, and we will describe one of the most modern installations using turbine electric drive, which was placed in operation on the CARL D. BRADLEY in July, 1927.

Brief History of Turbine Electric Drive on Great Lakes Cargo Ships

The Bradley Transportation Co. has for the past six or eight years closely followed modern forms of drive, especially with reference to reliability, adaptability to their particular service, maintenance and economy. In 1924, after studying the various types of drive, they decided to install a turbine electric drive on the T. W. ROBINSON, which was at that time being built by the American Ship Building Co. The arrangement of the apparatus is not ideal, as the engine room had been laid out for a reciprocating steam engine.

In 1925 the Bradley Transportation Co. decided to build the largest cargo ship on the Great Lakes and specified turbine electric drive. This ship was laid out for electric drive and is equipped with stokers, water-tube boilers, superheaters, air preheaters and a main turbine generator which furnishes all of the power for propelling and for the various electrical auxiliaries.

Before describing this ship in detail it should be pointed out that obviously ships are built for future operation, and one must endeavor to judge the probable increases in their operating cost, including interest on investment, wages, subsistence, fuel and ways and means of making the life of the various members of the crew more attractive.

The economical speed of a ship, as previously stated, depends to a certain extent on the efficiency of the prime mover and on the ability of the operators to decrease the time that a ship is in port. With means that are now available for communication between ships and headquarters, it is quite probable that the method of operating

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Paper presented before the Society of Naval Architects and Marine Engineers at the thirty-sixth general meeting held in New York city Nov. 15-16, 1928. C. R. Fisher is electrical superintendent for the Bradley Transportation Co. A. Kennedy Jr. is an engineer on the staff of the Federal and Marine Department of the General Electric Co.

ships will materially change in the next few years. One should investigate the probability of requiring in the near future increased power for operating ships at higher speeds so that there will be sufficient speed flexibility to enable the ship to be brought in to dock when it is free.

General Data of Carl D. Bradley

General Information

Service—Limestone carrier.

Shipbuilder—American Ship Building Co., Cleveland, Ohio.

Propelling machinery builder—General Electric Co., Schenectady, N. Y.

Owner—Bradley Transportation Co., Rogers City, Mich.

General Dimensions

Length over all ....638′ 8″

Length between perpendiculars....................615′ 0″

Molded breadth ....65′ 0″

Molded depth ....33′ 0″

Movable structural steel boom........long, 160′ 0″

Discharge belt conveyor ....wide, 60″

Tonnage

Weight of hull—7160 short tons (water in boilers and no fuel).

Displacement—Loaded to 20′ draft, 21,700 short tons.

Loaded to 22′ 6″ draft, 24,600 short tons.

Weight of boiler room equipment without water, 305 short tons.

Propelling Machinery

Boilers

Number—Two.

Type—Water tube. Equipped with automatic stokers.

Total heating surface sq. ft. (each boiler)..5,630

Total grate surface, sq. ft. (each boiler).. 100

Superheater surface, sq. ft. (each boiler)..1,340

Water wall surface, sq. ft. (each boiler).. 52

Superheat, degrees Fahr. 278

Working pressure, lb. per sq. in.................... 325

Engine

Number—One.

Type—Turbine generator with direct connected exciter.

Capacity—5600 kv.a., 2300 volt and 75/65 kw., 120-volt exciter.

Propelling Motor

Number—One.

Type—Form M induction.

Capacity—4800 s.h.p.

Revolutions—104.5.

Propulsion Control

Manually operated air break contactors with turbine speed control lever and water-cooled resistor.

Propeller

Number—One.

Type—4-blade sectional.

R.p.m.—Maximum, 104.5.

Projected area—79.23 sq. ft.

Developed area—89.12 sq. ft.

Disk area—203.69 sq. ft.

Condenser Apparatus

Type—Surface.

Square feet—4600.

Air pumps—Radojet.

Vacuum—1½″ absolute.

Electric Auxiliary Apparatus

One 75/60 kw., 3600/2700 r.p.m., 120 volt, direct connected d-c. generator to the main propelling generator.

One dual drive set consisting of one 250 kw., 1200/840, 120/240 volt, d-c. generator direct connected to one 750/520 kv.a., 1200/840 r.p.m. synchronous motor/generator direct connected to one turbine operating at 300 lb., 700 deg. total temperature condensing or noncondensing.

One 20 h.p., 1800 r.p.m. motor driven condensation pump driven by means of a squirrel cage induction motor.

One 10 h.p., 1800 r.p.m. mate's pump driven by means of a squirrel cage induction motor.

One 40 h.p., 1800 r.p.m. general service pump driven by means of a squirrel cage induction motor.

Two auxiliary ballast pumps each driven by a 20 h.p., 1200 r.p.m. squirrel cage induction motor.

One ash sump pump driven by means of a 50 h.p. slip ring induction motor.

One oil cooler pump driven by means of a 10 h.p., 720 r.p.m. slip ring induction motor.

One bilge pump driven by means of a 7½ h.p., 1200 r.p.m. squirrel cage induction motor.

Two sump pumps each driven by means of 25 h.p., 900 r.p.m. slip ring induction motor.

Two vacuum pumps each driven by means of a 15 h.p., 600 r.p.m. squirrel cage induction motor.

One circulating water pump driven by means of a 75 h.p., 600 r.p.m. slip ring induction motor.

One anchor windlass driven by means of a 55 h.p., 625 r.p.m., d-c. motor.

Four forward and center mooring winches each driven by means of a 35 h.p., 600 r.p.m., d-c. motor.

Two center deck hatch winches each driven by means of a 10 h.p., 675 r.p.m., d-c. motor.

Twenty-two ventilating fans.

One induced draft fan driven by means of a 40 h.p., slip ring induction motor.

Two forced draft fans driven by means of a 30 h.p. slip ring induction motor.

Three transformers each rated 200 kv.a., 2300/230/115 volts.

One storage battery, 400 ampere hour, 120 volt.

One gasoline set rated 5 kw., 110 volts.

One oil centrifuge.

One drinking water pump driven by means of a one h.p., 110 volt, d-c. motor.

One electric galley equipment, consisting of one 4.2 kw. bake oven, one 4 kw. coffee urn, one 22 kw. range.

One washing machine.

One boiler feed pump driven by means of 100 h.p., 1800 r.p.m. slip ring induction motor.

One ventilating fan for main propulsion motor driven by means of a 40 h.p. squirrel cage induction motor.

One air compressor driven by means of a 10 h.p., 720 r.p.m. squirrel cage induction motor.

One arc welder driven by means of a 7½ h.p., 1750 r.p.m., d-c. motor.

One refrigerating machine driven by means of a 5 h.p., squirrel cage induction motor.

One oil pump for damper regulator driven by means of a ¼-h.p. induction motor.

Two coal feeder belts each driven by 10 h.p., 600 r.p.m. slip ring induction motor.

Flow meters—integrating and recording flow meters have been installed to measure total steam flow to the main turbine, auxiliary steam, steam from each boiler and the water to the boilers.

One radio set, 2 kw.

All of the auxiliaries, with the exception of the fresh water pump and oil purifier, are driven by alternating current induction motors. Power for these auxiliaries is furnished from the main propelling generator.

Auxiliary Steam Apparatus

One steering engine—Size, 9″ x 9″.

Two aft deck winches—Size, 9″ x 10″

Stand-by Steam Units

One reciprocating boiler feed pump—10″ x 7″ x 18″.

One 75 h.p., 3500 r.p.m. steam turbine driven boiler feed pump.

One 15 h.p., 1430 r.p.m. steam turbine driven condensate pump.

General Description of Carl D. Bradley

Steam for propulsion and for auxiliaries is furnished by two water-tube boilers equipped with water walls, superheaters, air preheaters and stokers. The compact arrangement of using convection type superheaters, tubular air preheaters with vertical headers located on top of the boilers was suggested by W. W. Smith, chief engineer of the Federal Shipbuilding Co., who has been of great assistance on the problems arising in connection with this ship.

Slacked coal is taken from the coal bunkers by means of motor operated belt conveyors to the hoppers. The boiler-room crew has been reduced from three men per watch to one man per watch, with a net saving of six men in the boiler room.

All power for propulsion and for driving the electrically driven auxiliaries is normally furnished by one steam turbine direct connected to a three-phase alternating current generator and a direct connected auxiliary direct current generator. The propulsion control equipment consists of a steel panel on which the various electrical instruments are mounted and the levers for varying the turbine speed and manually operating air break contactors which make the necessary connections between the main alternating current generator, the propulsion motor and the water cooled resistor.

The various auxiliary alternating current motors have their starters with disconnecting switches made up in the form of a switchboard, and in this way they are accessible, easily inspected and located convenient to the operator. The various starting switches are located at the motors.

Auxiliary Power

Until quite recently, auxiliary power for driving electrically driven auxiliaries was obtained from separately driven turbine generators. The efficiencies of relatively small turbines are not at all satisfactory when compared with the efficiencies of the larger main unit. When the layout of the T. W. ROBINSON was made the installation of a motor generator set for obtaining auxiliary power from the main unit was considered, but, due to the limited time and for operating reasons, it was not installed. Operating experience showed, however, that the installation of this motor generator set would be an improvement.

Later a 250-kilowatt direct current generator driven by means of a 750-kilovolt-ampere synchronous motor was installed on the T. W. ROBINSON. This direct current generator has a constant voltage regulator so that the speed of the main turbine generator and motor generator

set can be varied from 100 per cent speed down to about 65 per cent speed. In this way auxiliary power is obtained at the water rate of the main unit, plus the losses of the motor generator set. This is more efficient than using auxiliary turbine generators. The T. W. ROBINSON was the first ship that was ever equipped in such a manner. In other words, it obtains auxiliary power from the main unit in a way similar to that used on many reciprocating steam engine driven ships, but with the electric installation there is a flexibility in the location of the auxiliaries and in being able to start or stop any of the auxiliaries when desired. This motor generator set has now been in service for over two years and has proven very satisfactory.

The CARL D. BRADLEY has gone a step further by taking the auxiliary power from the main generator and from a direct connected direct current generator.

It is necessary to have a stand-by for the direct connected direct current generator, and when loading and unloading there is a relatively large amount of direct current power required for the deck machinery. It was therefore decided, in addition to the direct connected auxiliary generator, that a motor generator set would be installed having a turbine direct connected to this motor generator set. This is commonly called a "dual drive set," as it may be driven by means of the alternating current motor or by the steam turbine, using under this condition the alternating current motor as an a-c. generator. This set is arranged so that in case the main propelling generator goes below 75 per cent revolutions the auxiliary turbine automatically picks up the auxiliary load. This permits the operator to decrease the main propelling turbine speed below the operating range of the dual drive set; that is, if for any reason the operator desires to reduce the main turbine speed below about three-quarters speed, this can be done by moving an interlock which disconnects the synchronous motor from the main generator. The auxiliary turbine will then be automatically driven by steam, which will furnish both direct and alternating current for the auxiliaries.

Table 1—Carl D. Bradley

Sept. 29, 1927—9 a.m. to 5 p.m.

Test No. 1

Time	Direct connected D. C. generator kw.	—Meter reading— Generator kw. hours	Motor input kw. hours	A. C. volts	Propeller R. P. M.
Constant	....	1000	1000	....	....
9:00	37.2	4180¾	3888½	2350	....
10:00	37.2	4184½	3892⅓	2350	104.5
11:00	37.2	4188½	3896	2375	102
12:00	37.2	4192½	3899.7	2400	103
1:00	42.0	4196	3903½	2450	101
2:00	38.4	4200+	3907	2400	103.5
3:00	40.8	4204	3911—	2400	103.5
4:00	38.4	4208	3914¾	2400	102.5
5:00	39.6	4212	3918	2400	102.5
Average	38.6	3900	3690	2390	103

Table 2—Carl D. Bradley

Sept. 29, 1927—9 a.m. to 5 p.m.

Test No. 1

Time	Pres.	Temp. cond. °Cent.	Cir. water in °Cent.	Feed and filter °Cent.	Vacuum gage	Temp. S. °Fahr. ther.	Steam °Cent. rec.
9:00	310	36	12½	72	Shut D.	690 691	365 367
10:00	310	38	12	59	27.8	694 684	360 368
11:00	310	36	12	57	27.6	678 690	358 368
12:00	310	36	12½	68	27.9	687 698	355 365
1:00	310	35	12	64	27.7	690 714	360 370
2:00	310	36	12	62	27.7	680 688	362 377
3:00	310	37	12	80	27.7	692 687	358 368
4:00	310	36	13	84	27.7	692 694	360 362
5:00	310	36	13	68	27.6	......	365 367

Under normal operating conditions a Great Lakes ship is operated at or above three-quarters speed, except when maneuvering. If it is desired to reduce the propeller speed below three-quarters speed, this is normally done on the CARL D. BRADLEY by inserting a resistor in the propulsion motor rotor circuit. The resistor has several steps so that several different speeds may be obtained, the lowest speed being approximately 25 to 30 revolutions. It is more economical, when operating the ship at or below three-quarters speed, to take this resistor loss of the propulsion motor than to reduce the main propulsion turbine speed and obtain auxiliary power by means of a separately driven turbine generator. The water rate of the main unit increases with decreased revolutions and, therefore, at low revolutions is quite inefficient. If main turbine is run at three-quarters revolutions, this improvement in efficiency due to revolutions and difference in water rates between an auxiliary turbine driven generator and the main unit more than offsets the loss in main propulsion motor water-cooled resistor.

Main Turbine

The main turbine has a self-contained lubricating system with a stand-by steam driven oil pump with regulator arranged so that, upon reduction of oil pressure, this steam driven pump automatically furnishes oil for the bearings and for the oil operated governor.

The governing system consists of a maneuvering governor which, by means of a lever on the control board, normally controls the turbine speed from 2700 to 3600 revolutions per minute. In case it is desired to go below 2700 revolutions per minute, an interlock is moved, which permits the operator to go down to any speed desired, but when the interlock is moved the dual drive set is automatically driven by steam. Varying the turbine speed varies the speed of the propelling motor. There is a pre-emergency governor which is set so that, if the turbine should exceed a predetermined speed, this will govern the turbine at a constant speed. In case

Table 3—Carl D. Bradley

Oct. 1, 1927—7:30 a.m. to 4 p.m.

Tests Nos. 2 and 3

Time	Direct connected D. C. generator kw.	—Meter reading— Generator kw. hours	Motor input kw. hours	A. C. volts	Propeller R. P. M
Constant	....	1000	1000	....	......
7:30	36	4344.6	4039+	2350	......
8:30	36	4348.7	4043	2390	......
11:00	36	4357.75	4051.5	2350	......
1:00	36	4365.25	4058.5	2450	......
3:00	....	4373.5	4066	2350	......
4:00	36	4377.3	4070	2450	......
Average					
11—4	36	3860	3580	2400	......
7:30—4	36	3960	3650	2390	130

Average engine room temperature, 80° Fahr.

the turbine speed exceeds the setting of the pre-emergency governor there is an emergency governor set at about 4000 revolutions per minute, which automatically trips the throttle valve, shutting down the turbine.

Table 4—Carl D. Bradley

Oct. 1, 1927—7:30 a.m. to 4 p.m.

Tests Nos. 2 and 3

Time	Temp. cond. °Cent.	Temp. feed and filter °Cent.	Vacuum gages	Vacuum column	Steam pressure gage
7:30	35½	79	28.0	27.85	310
8:30	36	72	28	27.8	310
11:00	36	68	28	....	310
1:00	37	80½	28	....	310
3:00	38	89	28	....	310
4:00	37½	82	28	....	310

Main Generator

The generator is provided with fans mounted on each end of the rotor which force air through the generator air coolers and back through a duct into the intake of the two fans. This insures an adequate amount of ventilating air which is free from dirt and moisture. Meters are provided so that the operator may at any time read the temperatures of the stator or rotor. Index thermometers measure the temperature of the generator air, and they are provided with alarms so that in case the air temperature exceeds a predetermined value the operator is notified of this increased air temperature.

Propulsion Motor

The propulsion motor is of the induction type, having a form wound rotor with slip rings. The motor speed may be varied by inserting resistance in the rotor circuit or decreasing the main turbine generator revolutions. The stator is provided with temperature coils so that the temperature of the motor stator may be read at the control station. An index thermometer is provided which measures the temperature of the discharge air from the motor, the motor being ventilated by means of a separately driven fan. This fan is driven by means of a squirrel cage induction motor, obtaining power from the main generator. The propulsion motor bearings are lubricated by means of disks attached to the shaft.

Control

The control apparatus consists of a main control panel with operating levers and indicating and integrating instruments. The total power generated by the main generator and the power input to the propulsion motor is measured by integrating watthour meters. There are no exposed live parts on any part of the control panel. The generator field rheostat, field switch, etc., are all controlled or operated from the control station.

Operating Tests

From Sept. 29 to Oct. 1, 1927, tests were conducted between Calcite, Mich., and Buffington, Ind., and between Buffington and Calcite on the Carl D. Bradley. Just previous to these tests the Bailey flowmeters were calibrated by means of water columns and the electrical instruments closely checked.

The tests consisted of weighing the coal and measuring steam and water by means of flowmeters. The electrical output of the main propelling generator and input to the propelling motor and the alternating current electric auxiliaries were measured by watthour meters.

The test run Sept. 29 was from 9 a.m. until 5 p.m., readings being taken every hour. Tabulations of these readings are shown on Tables 1 and 2. From 9 a.m. until 10:40 a.m. no steam was extracted from the main unit for heating the feed water as the water rate of the main unit was being checked, but at 11:40 a certain amount of steam was extracted for this purpose. Extracting steam for the feed water heater should decrease the fuel consumption approximately 2.5 to 3 per cent.

It was impossible to determine accurately the vacuum as the mercury column could not be read. The readings taken on vacuum gages show a poor vacuum, which was later found to be due to air leaks. An improvement in vacuum to 1.5-inch mercury absolute should result in a decreased fuel consumption of approximately 5 per cent.

The boiler feed readings used in the boiler test were an average of three sets of readings, two of these sets of readings being steam readings and the third readings water. The only accurate way to determine the amount of steam used is by weighing the condensate, but unfortunately this could not be done. We are, of course, primarily interested in the coal used per shaft horsepower hour for all purposes, or the coal used per ton-mile, and this was accurately determined.

The alternating current generator

Table 5—Carl D. Bradley

1927

Trip No.	Time—Full speed hr. min.	Check hr. min.	Delay hr. min.	Loading hr. min.	Unloading hr. min.	Total hr. min.	Miles	Gross tons	Pounds coal	Gen. kw. hr. at sea	Motor kw. hr
						76 08	....	....	....	....	....
5	56 49	1 19	2 26	8 48	6 46	83 22	811	15,205	344,000	217,500	200,500
6	57 22	10 34	....	9 19	6 07	74 48	811	14,640	340,000	218,200	201,000
7	56 46	1 23	....	10 05	6 34	75 00	811	14,458	358,000	226,000	210,800
8	57 46	2 53	....	7 30	6 51	74 40	811	14,175	362,000	227,300	210,300
9	56 35	1 40	....	9 45	6 40	74 17	811	14,891	368,000	216,200	201,500
10	56 17	1 27	....	10 18	6 15	76 23	811	14,673	362,000	209,000	161,300
11	56 00	8 22	....	6 05	5 56	74 14	811	14,105	356,000	216,000	203,000
12	56 03	1 51	....	10 00	6 20	76 02	811	14,438	332,000	222,000	209,500
13	56 17	1 24	....	11 52	6 29	74 19	811	14,781	324,000	220,800	206,700
14	56 20	1 39	....	10 29	5 51	73 19	811	14,516	342,000	220,000	204,000
15	55 33	1 33	....	10 19	5 54	71 55	811	14,278	350,000	217,000	202,000
16	56 03	1 14	....	8 54	5 44	78 49	811	15,187	358,000	217,000	205,000
17	61 08	1 23	....	10 41	5 37	93 47	811	14,587	318,000	241,000	225,000
18	75 36	2 26	....	8 48	6 57	77 20	1,050	12,547	470,000	279,500	261,000
19	56 01	1 44	2 41	11 42	5 12	76 14	811	16,312	364,000	225,500	208,300
20	57 07	1 04	2 13	10 22	5 28	73 48	811	14,490	362,000	225,532	210,500
21	59 38	58	....	8 20	4 52	75 48	811	15,724	368,000	239,600	216,500
22	59 43	1 38	....	9 17	5 10	73 00	811	15,593	362,000	236,000	220,200
23	57 08	1 40	....	9 07	5 05	73 05	811	15,323	362,000	224,000	210,000
24	59 40	1 30	....	6 26	5 29	76 06	811	13,866	372,000	241,000	234,000
25	58 18	1 42	....	10 13	5 53	71 51	811	14,856	396,000	242,500	227,660
26	56 53	1 33	....	8 36	4 49	73 55	811	14,838	396,000	223,540	209,500
27	57 50	1 34	....	7 50	6 41	71 13	811	14,752	396,000	222,000	207,000
28	56 54	1 17	....	7 10	5 52	74 11	811	14,599	382,000	214,000	201,000
29	58 49	1 31	1 23	7 13	5 15	42 31	811	12,554	378,000	218,000	207,000
30	28 07	27	2 07	5 07	6 43	78 12	397	12,554	200,000	108,800	102,700
31	57 52	2 03	....	11 01	7 16	80 14	811	13,929	370,000	217,000	203,500
32	59 25	1 26	1 44	9 38	8 01	78 45	811	14,017	400,000	239,500	222,500
33	57 05	1 13	4 09	10 47	5 31	80 59	811	14,231	380,000	218,500	197,500
34	58 16	1 16	6 43	9 07	5 37	....	811	14,550	378,000	224,500	209,500
Total	1,713.35 hr.	61.73	23.43	274.82	180.91	2,254.24	24,155	434,669	10,850,000	6,658,272	6,188,960

kilowatt output and propelling motor input were determined by means of integrating kilowatt hour meters. The difference between the generator output and motor input was the amount of power used by the alternating current auxiliary motors. The amount of power furnished by the direct connected exciter was determined by taking readings of the ampers and volts. These readings are shown on Table 1.

Knowing the main propelling motor efficiency from tests conducted in the factory, the power delivered to the propeller shaft was determined.

The total coal used during this run was 44,450 pounds, which is equivalent to 1.19 pounds of coal as fired per shaft horsepower hour for all purposes. At the end of this test it was discovered that combustion was not as good as it should have been, and therefore it was decided to take a second test with the ship running light from Buffington to Calcite. This second test was conducted Oct. 1, 1927, from 7:30 a.m. until 4 p.m. During this test maneuvering tests were taken to determine approximately the amount of torque utilized in stopping the ship. Due to these maneuvering tests a second set of readings was started at 11 a.m. The average coal as fired per shaft horsepower hour, including the maneuvering tests, was 1.17 per shaft horsepower hour, and the average from 11 to 5, or five hours, was 1.14 pounds of coal per shaft horsepower hour.

Flowmeters are not as accurate as weighing water by means of scales, but these tests are accurate insofar as the amount of coal burned and power delivered to the alternating-current auxiliaries and propelling motor. Knowing the propelling motor efficiency under the various conditions of operation, the exact power delivered to the propeller was obtained, and in this way pounds of coal used per shaft horsepower hour for all purposes determined. It should be noted that, although we have not approached central station efficiencies, we have very materially improved the efficiency of the propelling and auxiliary apparatus and the results compare very favorably with the modern ocean-going steamships.

Reversal Tests

The first reversal test was made on the CARL D. BRADLEY about 10 a.m. Oct. 1, readings being taken every ten seconds. The readings consisted of revolutions of the propelling motor and kilowatt input to the propelling motor, which has been converted into torque. From the time the captain gave the signal until the chief operated the levers there was a delay of about 12 seconds, as the chief wanted to know whether or not various observers were ready to take the readings. Ten seconds after the lever was moved, or about 22 seconds after the signal was given by the captain, the propeller was turning 50 revolutions astern with a torque of approximately 135 per cent. This torque gradually reduced until 52 seconds had elapsed when it was approximately 80 per cent of full load torque of the motor. The torque varied slightly until about 232 seconds after the signal it increased to 90 per cent; at 242 seconds after the signal the torque went up to 130 per cent and then dropped to 115 per cent torque. The ship was dead in the water three minutes and 55 seconds or 235 seconds after the signal. In other words, it looks as if the torque of the motor increased just as the ship came to rest in the water. The estimated speed of the ship just before the reversal test was taken was 14.7 miles.

About a week previous to the time this test was taken we made a full power reversal test with the ship loaded with approximately 12,500 gross tons of cargo. The ship was making an estimated speed of 14 miles an hour and had a mean draft of 20 feet. This test was made about 25 miles below Long Point bound for Buffalo, and the estimated depth of the water was 27 fathoms. The ship was stopped in 4 minutes 15 seconds. We observed the same high kilowatt input to the motor that was observed in the test conducted Oct. 1.

During the 1927 operating season the chief engineer of the CARL D. BRADLEY stated that in stopping the ship going through the Detroit river he had used approximately the same amount of power as was observed during these reversal tests.

There has been some discussion as to whether or not a propeller could utilize full horsepower in backing, and it appears from the tests conducted that this power can be used. We did not endeavor, in making these reversal tests, to stop the ship in the shortest possible time; the chief made a normal reversal. The wheel was reversed in about 20 seconds, which we do not believe abnormal with reciprocating engines.

Reciprocating Steam Engines

From various tests that have been conducted on reciprocating steam engines used on the Great Lakes it appears that most of these engines have anywhere from 25 to 50 per cent overload capacity. One reason for this is that, undoubtedly due to the small amount of power per ton displacement, they have obtained their excellent maneuvering characteristics due to this overload capacity and at times use this reserve capacity.

Self-Unloader Cargo Ships

A self-unloader type of ship has a relatively heavy A-frame with boom located in the bow, and this puts the bow of the ship down in the water. It therefore requires more power for a ship of this type to run light than a normal ore carrier type. There are, of course, many advantages which offset the disadvantage of requiring more power when running light with a self-unloader type of ship, which more than offset this disadvantage. Practically all delays in unloading are eliminated, and this would normally amount to about 10 per cent of the time the ship is in operation. This delay in port becomes more important the shorter the trip, or the greater the number of trips, and for ships making relatively short runs it

(*Continued on Page* 64)

Table 6—Carl D. Bradley

1927

No. Trips—30	Hours	Per cent
Average full speed	57.00	76.00
Average check	2.05	2.75
Average delay	0.77	1.05
Average loading	9.15	12.20
Average unloading	6.03	8.00
Total average	75.00	100.00
Average miles per hour		14.1
Average coal per mile (including loading and unloading, pounds)		450
Average cargo (gross tons)		14,450
Average miles per trip		805
Pounds of coal per ton-mile		0.031*
Coal per s. h. p. hr. all purposes including loading, unloading, time delay, checked, etc.		1.39
Average h. p. input to auxiliaries		354
Average s. h. p. of propelling motor		4550
Average coal per trip		361,600
Average ton-miles per trip		11,642,000*
Average h. p. input to d-c. auxiliaries		Not recorded
Average ton-miles per pound of coal		32.2*
Average cost of fuel per mile		0.90

*The Great Lakes operators, in order not to handicap their propelling engines, consider the ton-miles as the cargo carried multiplied by the total miles run light and loaded. In order to have these figures consistent with this practice, these values have been determined in this manner.

Pulverized Coal System Tested

Successful Tests on New System of Pulverized Coal Burning—Individual Mills for Each Burner—Independent Unit for Each Furnace

FUEL cost is one of the major items in ship operation. In a freight vessel for instance this item alone amounts to between 25 and 30 per cent of the total operating cost. It is, therefore, of primary importance to ship owners and operators that practical and dependable methods be developed to reduce this cost in any given service.

With the present low prices prevailing in boiler fuel oil it is increasingly difficult to show a saving using coal or even using the internal combustion engine in some routes. However, this condition does not prevail in all services by any means. In certain localities and between ports for instance where coal is cheap and plentiful and where oil of either kind is scarce and expensive, coal is still the economical fuel. The Great Lakes, for instance, is a good illustration.

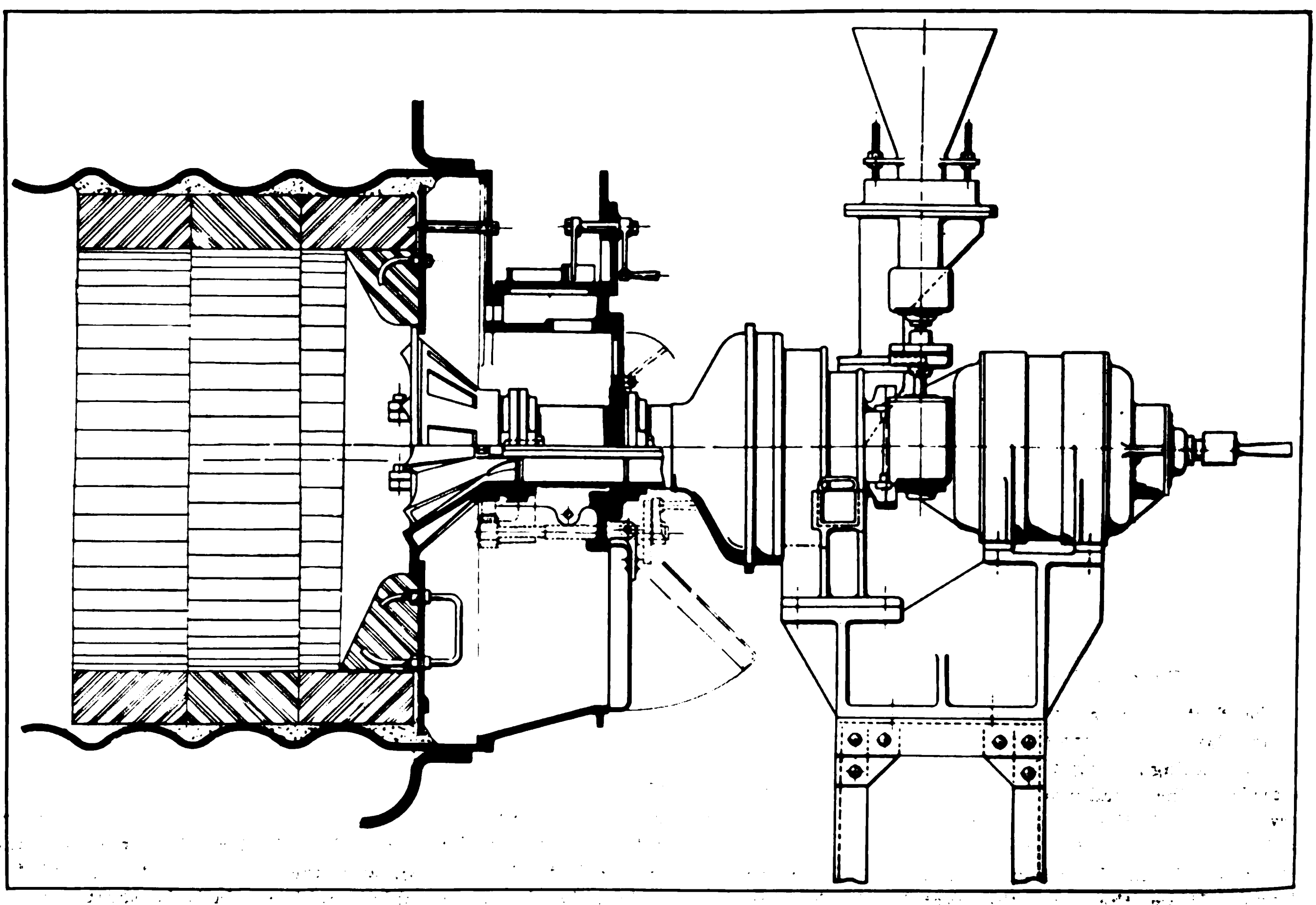
If an efficient and labor saving method of burning coal can be developed it will therefore be a great boon to shipping people all over the world. It will do away with complete dependence on one type of fuel, a condition which can only lead to increased prices, by introducing healthy competition.

Nothing could therefore well be of greater interest to marine engineers than the official tests recently concluded on a new type pulverized coal burner, at the fuel oil testing plant at League Island navy yard, which have effectively demonstrated the successful application of individual pulverizing mills for each burner to each furnace.

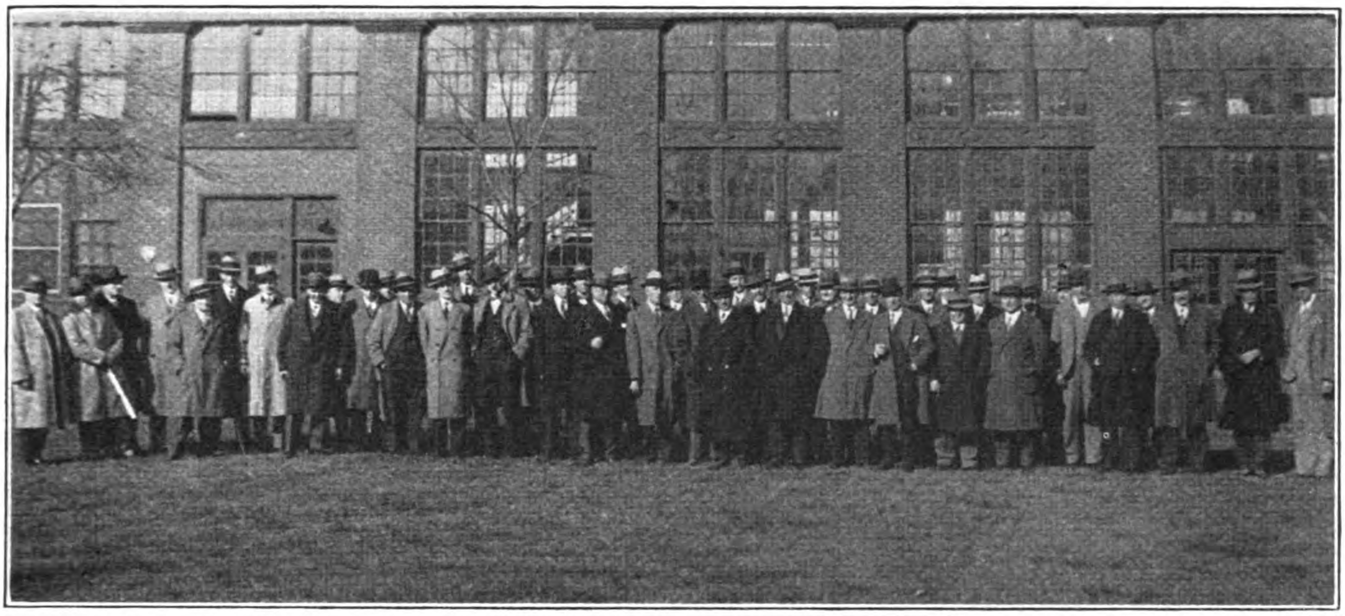
Complete data will not be available until all analyses have been made. Evidence at hand, however, together with the consensus of opinion of the engineers in charge of the test, indicate a splendid showing of combustion conditions and that the overall efficiency of the burner and boiler exceeded expectations.

These tests were the direct result of experiments made by the Todd Dry Dock Engineering & Repair Corp. over a period of two years in their Brooklyn plant. Many different types of burners were used as well as different applications of primary and secondary air conditions.

Up to this time all experimentation has been confined to the burning of pulverized coal in the furnaces of scotch marine boilers, marine engineers generally conceding that this was the most difficult condition to meet. With the successful accomplishment of this, the aim was to develop an apparatus that would have a universal application regardless of whether the present fuel being burned was oil or coal on the grate, and having in mind that cost of apparatus and its installation, together with its weight and bulk and simple method of operation, were all features of vital importance to the ship operator and owner. In comparison to systems heretofore used aboard ships,



TODD COAL PULVERIZER AND BURNER UNIT APPLIED TO SCOTCH MARINE BOILER, USING HOWDEN FORCED DRAFT



MARINE REPRESENTATIVES AT THE LEAGUE ISLAND NAVY YARD, PHILADELPHIA, NOV. 13, 1928, AFTER WITNESSING OFFICIAL TESTS OF THE TODD SYSTEM OF PULVERIZED COAL BURNING IN A SCOTCH MARINE BOILER. MORE THAN 60 MEN WERE THERE

there is a very decided difference in weight in favor of this system.

The apparatus which was finally developed and used in the tests is a remarkably simple machine, consisting of a motor or turbine-driven impact mill with two stages of pulverization, containing a fan to furnish primary or carrying air, and feeding apparatus to regulate the amount of coal going into the mill.

The equipment is very compact and rugged, a complete unit is installed on each furnace front. The flexibility of such an installation is an outstanding feature and will appeal to all operators, since it now becomes possible to operate all fires independently. No one unit is in any manner dependent upon its neighbor.

Need Not Alter Bunkers

Shipowners will appreciate the fact that it will not be necessary to alter bunkers or hull structure in any way to make an installation of these new type burners or for any system of coal conveying from bunker doors to pulverizers.

Burning of pulverized coal will always require the attention of operators, but when this feature is reduced to the simple manipulation of secondary air and amount of coal fed into the pulverizer as in this new type, it is then reduced to a minimum and comes within the easy range of the usual fireroom attendant.

The burners demonstrated were applied to a regular form of Howden forced draft front, with only such changes to the front itself as are usually made when changing from coal to oil burning and the secondary air coming from the Howden fan was approximately of the same pressure as used when burning coal on the grate. This is of importance since it admits of the use of the same draft fan and ducts as exist in the ship and does not destroy the usual coal-on-the-grate operation, should that for any reason be desirable.

The capacity of the burners demonstrated has been shown to be from 200 pounds to 600 pounds per hour per burner, this range is well within any requirement usually found on a scotch boiler furnace and this circumstance added to the fact that all burners are independent of each other, makes for a flexibility very much to be desired.

The grade of coal burned had a B.t.u. value of about 14,000 and due to the fineness of pulverization and complete combustion there has been no ash trouble as most of the ash is fine enough to pass away with the gases through the stack.

The flame produced is a short turbulent one and due to its turbulence the inert gases, usually found between the flame and heating surface, are brushed away, thus increasing the evaporating efficiency of this heating surface.

Large Group Views Tests

On Nov. 13, a company of representative shipowners and operators, together with the fuel conservation committee of the United States shipping board, visited the fuel oil testing plant at the League Island navy yard, Philadelphia, for the purpose of witnessing the Todd pulverized coal burners in operation during the final period of very exhaustive tests made by navy and United States shipping board personnel, and the consensus of opinion was that these burners were a very fitting tribute to the business of burning pulverized coal, and there were many expressions of satisfaction with this new development.

The Todd corporation has a number of inquiries from shipowners which indicate a keen appreciation of this subject by interested parties and it is expected that an installation of this system will be made aboard a freight ship in the near future, which no doubt will be watched by others equally anxious to equip their ships.

Order Two New Ships

Plans for construction of two 26,000-ton liners for service between San Francisco and Australia were announced Nov. 17 by the Matson Navigation Co. The vessels, which are to be the largest commercial ships ever constructed in the United States, will be capable of a sustained speed of 20 knots. Having accommodations for 730 passengers the vessels are expected to cost $6,500,000 each.

According to officials of the Matson Navigation Co., the vessels will be 625 feet long at the water line with a beam of 77½ feet. It is thought that the vessels will be in commission before October, 1931.

These vessels are to replace the SIERRA, VENTURA and the SONOMA which have been operating for more than 20 years between San Francisco and Australia, by way of the Hawaiian islands, Samoa and Fiji.

Atlas-Imperial Diesel Engine Co., has made announcement that the new headquarters for its eastern division has been opened at 115 Broad street, New York City.

Late Decisions in Maritime Law

Legal Tips for Shipowners and Officers

Specially Compiled for Marine Review
By Harry Bowne Skillman
Attorney at Law

STANDING by in a situation of danger and rendering whatever assistance is needed constitutes salvage service, it was declared in the case of South American Steamship Co. v. Atlantic Towing Co., 22 F. (2d) 16. Even a pilot who goes beyond his ordinary duty and renders services of a salvage nature is entitled to salvage. The court said that it could hardly be denied that the master of a tug, "if he had gone on board the steamship and himself have changed her course, would have rendered salvage service. On principle it would seem to make no difference that the course of the steamship was changed in conformity to his directions. It is immaterial who performed the physical act of steering the ship."

* * *

IN arriving at the amount of a salvage award it is proper to take into consideration, not only the value of the steamship and cargo, but also the fact that the lives of its officers and crew were in peril.—South American Steamship Co. v. Atlantic Towing Co., 22 F. (2d) 16.

* * *

A STIPULATION in a bill of lading requiring notice of loss before removal of goods from the wharf and the institution of suit within three months after notice is ordinarily valid and enforceable, but the clause should not be applied in any case, unless it is reasonable to do so. Events subsequent to the issuance of the bill of lading may be considered, it was said in the case of K. Ikuno v. Morris & Co., 22 F. (2d) 140, and among others, the accessibility of the ship to the process of the courts.

* * *

WHILE a dredge may maintain her position and he held free from fault, she must be free from fault in the location she selects. Ordinarily a dredge, lawfully engaged in digging, collided with by a passing tow, will be regarded free from fault, if there is ample free water for passage, or where an oncoming tug and tow have full opportunity to see her location and visualize the hazards of passing, said the court in the petition of Cahill Towing Line, Inc., 22 F. (2d) 273. But there are limits which even a dredge so engaged may not exceed. To place her in waters in the path of navigation, where she becomes a hindrance and obstruction, is negligent.

* * *

THE owner of a wharf has the same rights of controlling it as with regard to any other realty, and these rights are not changed by the circumstance that the owner is a common carrier and uses the wharf in its business.—Pendleton Bros. v. Northern Coal Co., 22 F. (2d) 317.

* * *

AS BETWEEN the mortgagor and mortgagee of a vessel, and in the absence of express agreement disclosing a contrary intention, freights fully earned while the mortgagor is in possession belong to the mortgagor, but freights earned after the mortgagee takes possession of the property under his mortgage belong to the mortgagee. The same rule applies as between the owner of a vessel and an agreed purchaser in possession under an executory contract to purchase the ship, it was held in United States v. Sterling, 22 F. (2d) 323. In such cases freights fully earned while the agreed purchaser is in possession belong to the purchaser, but freights earned after the owner retakes the ship for breach of the purchase agreement belong to the owner.

* * *

THE owner of a vessel owes to stevedores engaged upon it the duty of exercising reasonable diligence to furnish a reasonably safe place in which to perform services, as well as appliances reasonably suited to the purpose for which they are customarily used; and the owner owes the further duty of giving stevedores notice of any latent dangers in the ship or appliances.—HENRY S. GROVE, 22 F. (2d) 444.

* * *

EVERY vessel under steam, whether under sail or not, is to be considered a steam vessel, and a steam vessel is deemed to be any vessel propelled by machinery. A schooner being propelled by a small power boat made fast to her stern is for the time a steam vessel within pilot rules as to lights.—IDA B. CONWAY, 22 F. (2d) 182.

* * *

WHAT is to be regarded as reasonable and prudent navigation in each situation depends on the lawful customs of vessels, as well as upon special conditions of wind and tide and passing traffic.—FORT ST. GEORGE, 22 F. (2d) 195.

* * *

IN GENERAL average, the enterprise is necessarily considered as a whole. In apportioning the loss, regard is had to the interest of the respective parties, but in other respects no separate interest is recognized. Until, therefore, some portion of the property has been separated from the rest to the exclusion of any common interest with it, every risk which affects the enterprise as a whole must be regarded as affecting each portion of the property engaged. Every owner has a right at any time, on payment of freight for the entire voyage, to withdraw his portion of the cargo before termination of the voyage, and the cargo thus withdrawn is exempt from contribution for any subsequent loss or expense. When a cargo owner finds a vessel with his cargo on board in a port of refuge needing repairs, which can be effected only at a cost to him of more than he would lose by taking his property at that place and paying the vessel her lawful charges against him, he may undoubtedly pay the charges and reclaim his property. The law does not require him to submit to a sacrifice of his own interests for the benefit of others. —Willcox, Peck & Hughes v. Alphonse Weil & Bros., 24 F. (2d) 587.

* * *

THE owner of a dredge damaged in collision is entitled to recover demurrage for the time necessary to repair the damage, though other repairs were made at the same time, where they were not necessary at that time and did not delay the collision repairs.—Jones v. United States, 22 F. (2D) 581.

Low Cost of Lake Transportation

Major Importance of Highly Efficient Loading and Unloading Equipment at Shore Plants — Port Time Is Reduced to a Minimum

By Henry Penton

THE Society of Naval Architects and Marine Engineers and transportation interests as a whole, which includes builders, owners, shippers and operators, are to be congratulated upon the generous contribution by the American Ship Building Co. through A. W. Cross, its naval architect in his presentation of the paper on *Recent Developments in Shipbuilding on the Great Lakes.* Mr. Cross is peculiarly competent as to his subject since he has lived with it all his life and through its most intensive development. This familiarity also has its drawbacks in the preparation of such a paper because the intimacy tends to minimize the outstanding features of the subject.

Since the development of the type ship cannot be disassociated from that of the shore plant—in fact the two are interwoven—I have taken the liberty of offering some data which may help those unfamiliar with the trade to a better understanding of the factors underlying and controlling such development. The papers by W. I. Babcock in Vol. 13, R. B. Sheridan in Vol. 17, Professors Sadler and Lindblad in Vol. 30 and Professor Lindblad in Vol. 31 of the transactions, will supply considerable additional historical and other pertinent data and should by all means be read in conjunction.

Because, in such relatively short voyages, reduction of port time is all-important, much more so than the question of speed of ship, every effort has been bent in that direction. Thus, the shore plant has been steadily improved to economize the ship's time and the ship has been coincidentally, modified to facilitate and take advantage of the utmost possibilities of the shore plant.

As regards the ship, a design is aimed at which assumes the highest rate of loading or unloading to be a sustained or standard performance and it may therefore be of interest to show some of these rates and their influence on transportation and shipbuilding. Some of them are frankly tests, such as the loading of the S. S. KERR, but indicate a condition liable to recur at any time or even become established practice, because the history of the trade is that what was phenomenal yesterday is commonplace today. A little later will appear evidence of how rapidly the test load conditions of 1921 were being approximated in 1927.

This article was presented by the author, Henry Penton, to the Society of Naval Architects and Marine Engineers as a written discussion on the paper by A. W. Cross on Recent Developments in Shipbuilding on the Great Lakes. It is a clear statement of the real nub of the marvelously efficient transportation system of the Great Lakes, by a man who has had many years of intimate contact with the design and construction of vessels for Great Lakes service.

Ore Loading Speeds

At this time, however, the test loading rate of 12,508 gross tons of ore in sixteen and one-half (16½) minutes into the steamer D. G. KERR in 1921 has not been disturbed. This test merely established a rate of flow for ore with a spout into every hatch on 12-foot spacing. It does not mean that the ship was cleared of water ballast and ready to depart in that time. It does, however, establish a condition.

Henry Penton

Well known Great Lakes consulting marine engineer, elected a member of the council of the Society of Naval Architects & Marine Engineers at the last annual meeting

Average loading conditions may be presented in a number of forms but it is thought best to give here the ordinary procedure which involves shifting the ship under the spouts, handling water ballast, etc.

The largest of the ore docks, the Duluth, Missabe & Northern railroad, at Duluth, in 1927 loaded 1672 cargoes averaging 9200 gross tons each, in an average loading time of 2 hours, 55 minutes, and average time at dock, including all shifting, handling water ballast, etc., of 4 hours, 5 minutes.

The Lake Superior & Ishpeming dock at Marquette loaded 290 cargoes averaging 8100 gross tons each in an average loading time of 69 minutes per cargo. The time shifting and pumping is not stated but would add about an hour to each.

The Great Northern dock at Superior gives a random list of ships averaging 11,260 gross tons per cargo with an average loading time of 2 hours, 42 minutes and total time at dock of 3 hours, 24 minutes.

The manager of this dock advises me as follows: "On many grades of ore it is now no longer a question of how fast the docks can give the ships the ore but rather as to how fast the ships can receive it. There are many instances of putting two runs into a vessel of between 9000 and 10,000 tons in about a half an hour."

Herein lies the evidence of rapid approximation to the test loading figures referred to above. Thus the ships are faced with the necessity for fast shifting and rapid handling of water ballast if they are not to take detention and the next move appears to be up to the ship. It is only fair to say that as to these items (shifting and handling ballast) the personnel is even more of a factor than the designer.

Ore Unloading

The ore unloading rate has been accelerated to the present figure for a full cargo of 11,445 gross tons in 2 hours, 20 minutes with five rigs working, an average of 16.38 tons per minute per rig. This rate, established in the summer of 1927, has not been disturbed at last available reports and shades off with different docks, ships and cargoes. The ship described by Mr. Cross unloaded on Sept. 1 of this year the largest ore cargo moved on

the Great Lakes up to that time, 14,240 gross tons (about 16,000 net tons) in 4 hours, 45 minutes with four rigs working. It is interesting to compare this cargo, on a draft of 20 feet 1 inch on arrival, with the deadweight figure given by Mr. Cross in his paper, of 14,000 long tons at 20-foot draft. This cargo was moved after Mr. Cross had prepared his paper and is an example of careful calculation. Ordinarily the ship is not shifted during unloading.

Coal Loading Speeds

With respect to the other chief bulk cargo commodity, bituminous coal, the best cargo loading rate available stands at 3400 net tons per hour which means an average of 62 cars per hour handled by the car dumper. This rate also shades off with different docks and ships. A somewhat faster rate as to cars per hour for a short period was recently reported but the tonnage figures are lacking.

It is to be noted that since the car dumper is a fixture and the ship must be shifted at least once for each hatch and generally more, the loading rate involves much handling and the smartness of the equipment and personnel have much to do with the record made by the shore plant.

This shifting during loading of both ore and coal requires powerful winches and expert handling, and wire cables are used exclusively. The wire used generally is 1⅛-inch, which is really a little light for the duty but it has been found that a larger wire is too heavy for the men ashore to handle quickly and safely. The winches are, in general, single drum, single geared, of rugged construction and handy and fast. Motor driven winches with automatic tension device have been employed in a few instances and their more extended use may be looked for. The almost continuous and rapid handling and control of a mass of the order of 20,000 tons with mean drafts varying ofttimes at the rate of two or three inches per minute is a real problem.

Handling Grain Cargoes

Grain loading rates have advanced to about 3900 net tons per hour and unloading to about 1500 net tons per hour. Both loading and unloading involve shifting of ship, especially the former, and are included in the time rates.

Aside from the test loading of the S. S. KERR, already referred to, all of the rates quoted represent substantial advances in despatch. Thus, while the average size of ore cargoes has, in 15 years, increased 12 per cent and of the largest individual cargoes about 50 per cent, in spite of lowered lake levels, the port time has been reduced even more sharply. To go back not more than ten years we find that the average total port time per round trip for the bulk freighter has for the five years 1923-1927 inclusive been reduced to 22.3 hours as compared with 33.8 hours for the preceding five years, or 33 per cent. For the year 1927 it was below 18 hours. Of course these averages cover both one-way and two-way loading and discharging, although there are numerous instances where cargoes much above the average have been worked both ways well within the port time noted above. A recent instance is a two-way cargo, averaging 11,250 tons, loaded and unloaded, representing say 45,000 tons of handling, in total port time of 20¾ hours including shifting at each end from unloading dock to loading dock, a matter of about an hour in each case. The S. S. HARRY COULBY on the occasion of the delivery of the record ore cargo already referred to shifted and took aboard almost 15,000 net tons of coal in a total port time for unloading and loading of 10 hours.

Using the figure for 1927 we find that the reduction in port time alone is equivalent to an increase in fleet capacity of slightly better than 10 per cent. It is not difficult to find in these figures an explanation of the present inactivity of lake shipyards. Such pronounced improvements in efficiency of the system as a whole go a long way in offsetting even considerable expansion in the volume of commodities to be moved.

Rail and Water Rates

It is worthy of note that these improvements have been steadily reflected in reduced carrying charges, even during a period when charges in every other line of business, and particularly transportation, have undergone substantial advances, and in spite of the much higher wage scale of the lake fleet. For instance, the existing rate on iron ore from the head of Lake Superior to Lake Erie ports, averaging 875 miles, is 70 cents per gross ton as compared with the average for the years since 1916 of 90 cents, or, if what we may call the war years are omitted, of 74½ cents. This compares with the rail rates from mines to loading docks, averaging somewhere around 65 miles, of 81 cents in 1927, or, over the same period as above, about 90 cents, the rail haul being all down grade.

The earliest published rail rates available for the ports at the head of the lakes are for 1892, and show the rates from mines to docks that year, with much shorter average haul than now, to average 86 cents for a total tonnage of slightly over 4,000,000 tons as against a tonnage of over 47,000,000 in 1926. The same year (1892) the lake rate was $1.20 cents. Both rates have fluctuated somewhat at times but both have been fairly stable for the past several years, so that over a 35-year period the lake rate has declined 42 per cent and the rail rate from mine to dock only 6 per cent.

In view of the wide dispersion of the ore from Lake Erie receiving ports, with accompanying variations in tonnages and rail rates, only a general survey of this field has been possible which indicates that rail mileages and rates approximate 125 and $1 respectively, based on 1927 data as to tonnages and stable rates for the past six years. The combined rail hauls and rates at both ends therefore give a ton-mile rate of practically one cent as compared with the water rate of 0.08 cents.

Influence of Efficient Transportation

The same thing is true as regards coal, which provides return cargoes from Lake Erie ports to the upper lakes and to the extent of about 3/5 of the ore movement, the relative average round figures for 10 years being 54,000,000 for ore and 28,500,000 for coal, with peaks of 61,000,000 and 34,000,000 both in net tons. Of the coal roughly one-half goes to Lake Superior with about the same mileage as for ore and a rate of 40 cents. Therefore two-way loading gives an average ton-mile rate of 0.062 cents. This is not only by far the cheapest transportation in the world but has been achieved in the face of steadily advancing rates in all other fields and mounting costs of operation as to fuel, pay roll and subsistence, and with satisfaction to the owner. For instance to go back again to 1892, fuel cost $2.50 to $2.75 per ton in bunkers in Lake Erie ports compared with $5 to $5.50 per ton in 1926 and with a wage scale in about the same proportion.

It may be of interest to note that the one-way movement of iron ore alone through the Soo canals was, in 1927, equal to the reported combined two-way movement of all classes of cargoes through both Panama and Suez canals. That year represented the largest movement in the history of the last two canals but not by any means peak movement at the Soo.

The influence of the bulk freighter

on the general industrial activities of the country is very generally underestimated. It is the general impression that its development is due to the steel industry and the situation of the ore deposits but it would be more nearly correct to assert that the exact reverse is true. A survey made some years since by *Iron Trade Review* showed that imported ores, amounting in 1927 to about 4 per cent of the total consumption of the United States, met the lake ores on even terms as to costs in eastern Pennsylvania, at about 75 miles from tidewater, and every advance or recession in carrying charges therefore tends to shift this competitive front with its corresponding diversion of transportation to foreign tonnage and shipbuilding. The fact that this front has not moved inland with the expansion of the steel industry seems to show conclusively the dependence of the industry on lake transportation.

The same thing is true of coal and grain. The 34,000,000 tons moved in 1927 from the Ohio valley to the northwest would have had to remain in the ground but for the lake freighter. The 15,000,000 tons of grain moved at a ton-mile cost of 0.07 cents, provided an outlet for surplus that would otherwise have no market and would consequently depress the price of the entire crop.

Acknowledgement is made to the Lake Carriers' association, Cleveland, and to the management of the Duluth, Missabe & Northern and the Great Northern ore docks at Duluth and Superior for data incorporated herein.

A Diesel Electric Dredge for Panama

THE hydraulic dredge LAS CRUCES is now nearing completion at the works of her builder, the Ellicott Machine Corp., Baltimore.

While the Panama canal has owned and operated hydraulic dredges for many years, both in the original digging and in maintenance work, this machine is larger and far more powerful than any of the dredges previously used. In fact it is probably the most powerful hydraulic dredge ever built. Bids and plans were received from the largest dredge builders in the United States, and, after they had been carefully examined, the canal officials awarded the contract for this mammoth dredge to the Ellicott Machine Corp., as its bid was considered lowest in price, meeting all the requirements of the canal specifications to the best advantage.

Four diesel engines directly connected to generators form the main power units, and all machinery is electric driven. The dredge is capable of pumping through a pipe line over two miles in length, and will have a capacity of 500 to 1000 cubic yards per hour, depending on the material being dredged. The displacement in working order will probably be approximately 2500 tons. The hull, which has a length of 226 feet, width of 50 feet and depth of 14 feet, is built of steel, with numerous watertight bulkheads to insure the safety of the dredge in case of collision. The scantlings of the hull are in excess of that required by the American Bureau of Shipping rules. In addition to the watertight bulkheads a watertight trough or flat has been built into the hull through which the discharge pipe runs. This makes the discharge pipe easily accessible and prevents leakage into the hull in case of breakage in the discharge pipe. The fuel and fresh water are carried in tanks on each side of the hull, sufficient for 30 days operation.

The lower deck house is of steel, extending practically the full length of the dredge and 36 feet wide. Traveling cranes are provided over all of the machinery.

Above the steel deck house are steel living quarters for 80 men. These quarters include separate staterooms for the officers, recreation rooms, mess rooms, a completely equipped galley and cold storage equipment.

The dredging pump is of 24-inch size and is located in the pump room in the forward end of the hull. The shaft from the pump passes through a watertight bulkhead to the main motor room. The main pump motor is of 2500 shaft horsepower, double armature type. The control for this motor provides for a wide range of operating conditions.

The agitating ladder is capable of digging to a depth of 60 feet and to handle the hardest materials. It is 90 feet long, and weighs approximately 400,000 pounds. The motor for the agitating machinery is mounted directly on the ladder and is a 350 horsepower. The control equipment

Diesel Electric Hydraulic Dredge Las Cruces for Panama Canal—Dredging Pump of 24-inch Diameter Suction

provides for cutter speeds from 12 to 20 revolutions per minute.

The hauling and hoisting machinery is divided into two parts. At the forward end of the dredge three drums are provided, one for lifting the ladder and two for swinging the dredge. The motor for the forward hauling machinery is 100 horsepower variable speed, controlled from the pilot house. At the after end of the dredge are two drum winches for raising the spuds, these being driven by 100 horsepower variable speed motor, also controlled from the pilot house.

The main diesel engines are four in number, each of 911 horsepower, and they were built by the Fulton Iron Works Co., St. Louis. These engines are of 8-cylinder, 4 stroke cycle trunk piston air injection type. The normal operating speed is 204 revolutions per minute. The bore is 17½ inches and the stroke is 24½ inches. One of these engines weighs approximately 171,000 pounds. Each engine is directly connected to one main and one auxiliary direct current Westinghouse generator. Two of these engines with their generators are located in the forward engine room, while the other two are located in the after engine room.

Is All Electric Drive

The electrical equipment is of Westinghouse manufacture and the wiring is of the highest grade for marine service. The main switchboard is located on the main deck between the two engine rooms and provides panels for each main generator, each auxiliary generator, main pump motor circuit, cutter motor circuit, hauling motor circuits and the smaller auxiliary motors. The auxiliary equipment is very complete, including emergency generator sets for use when the main engines are shut down, motor driven air compressor, circulating pumps, fire pump, service pumps, fresh water and sanitary pumps, bilge pumps, fuel oil pumps, a complete machine tool outfit and ice machine.

The dredge is being built complete with quarters at the works of the Ellicott Machine Corp. and will be delivered to Cristobal, Canal Zone, afloat, ready to go to work.

The government specifications for the dredge were issued under the direction of the former governor general of the canal, Col. M. L. Walker; and under the immediate supervision of Col. Harry Burgess, chief engineer of maintenance—and at present governor of the canal; Capt. R. P. Schlabach, naval constructor, formerly superintendent of the mechanical division; and John G. Claybourn, superintendent of the dredging division

The Washington office of the Panama canal superintended the work of construction, under the direction of A. L. Flint, chief purchasing officer, A. E. Doying, chief inspecting engineer, and C. H. Johnson, of the mechanical division, and B. E. Swain, inspector of machinery installations.

To Build Diesel Ship

A loan to aid in construction of a 9400 deadweight ton combination passenger-cargo vessel of 13 knots speed, to be built by the Sun Shipbuilding & Dry Dock Co. for the American South African Line Inc., was approved by the shipping board Nov. 22. The amount of the loan will be not more than 75 per cent of the cost of the vessel, in accordance with the merchant marine act of 1928.

The vessel to be constructed, contract for which has already been entered into with the shipbuilder, is to be propelled by twin screws driven by two engines of the four-cylinder Sun Doxford opposed piston reversible type. The construction contract calls for completion of the vessel by Oct. 10, 1930. The ship will be operated over the New York-South African route of its owner. The line of which this vessel will be a part was purchased from the shipping board in 1925.

To Build Four Ferries

While detailed plans and specifications are not yet available, announcement is made that four automobile ferries are going to be built during the winter for service in routes out of Seattle. Three of these hulls are to be of steel. Two will be powered with diesel engines while turboelectric propulsion is under consideration for the other two.

The Puget Sound Navigation Co. is considering plans for two steel hulls, one 260 feet in length with capacity of 500 passengers and 80 automobiles for service between Seattle and Victoria. The second is expected to carry 80 automobiles and 1000 passengers between Seattle and the Puget Sound navy yard. Speed in excess of 20 knots is contemplated but the motive power has not yet been determined.

Plans being drawn for the Kitsap County Transportation Co. will provide for two 200-foot ferries, probably one hull of steel and the other wood, although Capt. John L. Anderson, president, stated that all the details have not been worked out.

Open Bids for New Ships for Export Line

On Nov. 5, bids were received in the offices of the Export Steamship Corp., American Export lines, New York city, for construction of four combined passenger and cargo vessels. A complete summary of the various bids for construction and specifications follows:

Bethlehem Shipbuilding Co., $2,158,000 for each vessel. and $89,000 for specifications B for each vessel. Time 18, 24, 30 and 36 months.

New York Shipbuilding Co., $2,250,000 for each vessel and $87,500 for specification B for each vessel. Time 18, 21, 24, and 27 months.

Federal Shipbuilding Co., $2,250,000 for each vessel and $75,000 for specifications B for each vessel. Time, according to specifications.

Maryland Drydock Co., $13,704,020 for the four vessels and $97,643 for specifications B for each vessel. Time, according to specifications.

Newport News Shipbuilding & Dry Dock Co., $2,587,000 for each vessel and $96,000 for specifications B for each vessel. Time 18, 22, 26 and 30 months.

Spear Engineering Co., $7,963,000 for the four vessels and $348,280 for specifications B for the four vessels. Time, according to specifications.

Sun Shipbuilding Co., $8,584,000 for the four vessels and $67,000 for the specifications B for each vessel. The Sun Shipbuilding Co., made an alternative proposal of $9,440,000 for diesel twin screw passenger vessels, four in number all complete. Time, first vessel 15 months and one vessel every four months thereafter.

Diesel Electric Ferry

A double-ended steel, diesel-electric ferryboat is now under construction for service on the present route of the Norfolk County Ferries Co, between Norfolk and Portsmouth, Va. The hull is being built by Spear Engineers, Inc., of Norfolk; the diesel engines are being constructed by the Bessemer Gas Engine Co. of Grove City, Pa., and the electric equipment will be furnished by the General Electric Co. It is expected to be ready for operation in the summer of 1929.

The new boat will have an overall length of 173 feet, and an overall beam of 57 feet. It was designed by Eads Johnson of New York. The power plant will consist of two diesel engines each rated 400 brake horsepower at 250 revolutions per minute, direct connected to two main generators each rated at 270 kilowatts.

Marine Business Statistics Condensed

Record of Traffic at Principal American Ports for Past Year

New York

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	596	2,666,360	589	2,571,403
September	545	2,424,887	543	2,362,154
August	580	2,533,877	622	2,733,727
July	602	2,526,107	564	2,415,168
June	537	2,386,509	602	2,645,954
May	580	2,498,280	590	2,463,196
April	566	2,487,959	541	2,359,979
March	548	2,338,855	578	2,449,705
February	513	2,205,204	501	2,135,910
January, 1927	540	2,160,576	512	2,146,026

Philadelphia

(Including Chester, Wilmington and the whole Philadelphia port district)
(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	91	250,902	48	137,352
September	84	238,234	43	122,389
August	96	266,104	58	161,365
July	101	254,378	60	143,573
June	101	270,069	72	183,534
May	110	281,648	74	179,108
April	109	261,735	60	140,547
March	95	254,304	65	167,100
February	88	239,768	53	152,545
January, 1927	81	206,710	54	141,408

Boston

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	112	347,432	72	221,761
September	113	383,749	77	245,068
August	130	340,569	107	270,757
July	155	378,368	111	289,121
June	143	319,611	100	254,906
May	134	304,575	103	231,851
April	110	343,360	65	205,257
March	108	348,026	67	194,408
February	100	301,053	50	160,330
January, 1927	102	328,779	61	197,133

Portland, Me.

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	23	39,959	22	40,588
September	30	53,338	30	51,018
August	30	48,256	28	47,078
July	38	68,208	38	66,389
June	30	40,255	25	33,834
May	23	26,648	19	28,673
April	20	51,854	19	50,175
March	20	58,110	22	69,400
February	18	44,067	17	47,032
January, 1927	21	57,757	18	48,294

Providence

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	6	14,667	9	20,551
September	5	18,895	3	12,777
August	7	28,611	4	19,978
July	8	26,920	7	25,451
June	8	35,177	7	25,741
May	7	21,068	4	12,765
April	4	15,670	3	12,362
March	7	27,885	6	26,037
February	3	6,656	4	17,543
January, 1927	4	20,981	4	18,817

Portland, Oreg.

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	42	154,623	62	224,018
September	41	150,368	57	203,758
August	35	136,504	47	172,693
July	30	111,042	46	157,354
June	23	85,328	40	144,572
May	25	96,976	44	159,070
April	37	137,821	41	152,042
March	29	111,490	49	170,655
February	23	86,160	35	120,026
January, 1927	37	130,578	50	183,254

Baltimore

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	133	402,263	131	406,142
September	119	374,500	128	396,749
August	133	404,303	144	440,016
July	128	378,827	121	353,758
June	127	392,580	135	412,620
May	135	413,038	151	439,278
April	140	396,942	134	394,124
March	128	391,117	137	408,927
February	134	412,110	135	399,729
January, 1927	116	354,307	120	374,617

Norfolk and Newport News

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	12	33,817	66	173,729
September	21	64,366	69	178,508
August	19	50,096	83	208,639
July	15	33,548	81	212,471
June	19	42,454	63	155,944
May	25	58,472	78	207,857
April	15	35,122	81	189,564
March	18	39,102	89	209,171
February	13	32,925	77	206,680
January, 1927	14	29,831	75	202,997

Jacksonville

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	23	55,147	22	53,094
September	40	89,032	42	94,981
August	37	85,186	34	83,694
July	30	81,634	31	79,222
June	26	54,449	28	57,111
May	26	58,800	28	63,779
April	26	68,581	26	61,939
March	25	65,435	28	68,630
February	31	70,881	28	58,896
January, 1927	26	71,686	27	71,721

Key West

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	120	111,450	116	106,139
September	84	60,079	86	62,698
August	91	73,771	89	69,532
July	86	65,838	88	67,720
June	98	83,417	93	78,006
May	134	117,930	129	112,303
April	101	75,140	102	76,450
March	119	96,746	112	94,408
February	121	91,928	109	88,819
January, 1927	110	85,955	123	85,750

Mobile

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	89	185,031	71	166,606
September	85	209,709	74	193,661
August	90	186,097	78	178,036
July	101	209,990	82	189,008
June	85	176,088	82	178,337
May	102	227,194	90	209,449
April	114	217,803	105	203,515
March	107	242,444	97	246,634
February	94	271,569	83	226,210
January, 1927	117	309,644	82	216,381

Seattle

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	62	245,420	60	243,778
September	57	229,718	66	254,503
August	55	220,858	53	228,378
July	64	261,850	58	228,946
June	44	180,482	44	185,765
May	53	206,254	61	239,241
April	56	226,257	54	210,908
March	46	191,601	46	196,871
February	54	210,176	53	207,173
January, 1927	50	206,743	62	239,133

New Orleans

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	259	682,184	329	627,989
September	228	617,636	248	661,643
August	264	667,055	265	690,841
July	260	659,457	245	615,234
June	253	615,672	263	640,136
May	263	671,333	261	647,504
April	254	656,537	265	666,845
March	265	669,301	282	720,407
February	238	627,445	236	616,772
January, 1927	271	725,935	272	697,301

Charleston

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
July, 1928	26	59,204	27	61,976
May	29	71,467	32	78,781
April	26	60,165	21	52,590
March	29	79,789	27	67,472
February	26	74,244	27	73,168
January	32	83,419	52	150,260
December	27	65,379	25	63,354
November	32	77,911	33	81,978
October	37	95,478	36	95,070
September, 1927	39	102,874	39	101,044

Galveston

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	41	110,825	135	420,534
September	26	69,433	98	313,816
August	31	91,959	78	261,804
July	41	91,686	68	196,424
June	20	52,884	64	210,110
May	35	96,852	44	126,027
April	32	85,685	43	132,534
March	35	75,924	47	121,106
February	27	63,696	52	147,378
January, 1927	32	83,419	52	150,260

Los Angeles

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
September, 1928	188	504,630	189	482,133
August	164	539,454	160	514,978
July	153	547,612	131	485,817
June	152	434,811	114	428,885
May	236	545,132	150	478,553
April	183	519,918	184	498,424
March	182	522,110	222	483,105
February	164	466,319	172	439,193
January	167	477,974	165	437,080
December	195	561,525	158	517,376

San Francisco

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
October, 1928	165	620,117	155	596,750
September	180	623,999	175	579,262
August	185	674,832	164	643,965
July	147	662,437	122	454,802
June	149	567,839	141	539,600
May	174	869,626	175	625,910
April	157	580,506	150	565,111
March	179	629,773	162	648,057
February	158	501,080	165	640,220
January, 1927	145	602,389	154	607,904

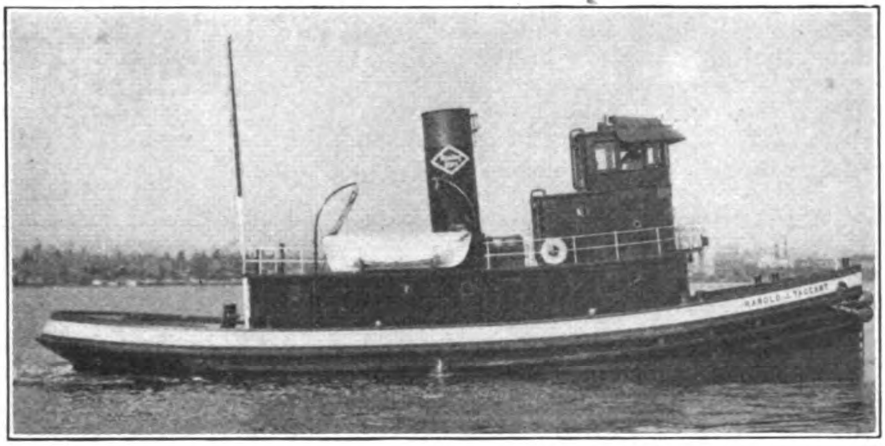
Port Arthur

(Exclusive of Domestic)

Month	—Entrances— No. ships	Net tonnage	—Clearances— No. ships	Net tonnage
July, 1928	24	78,538	33	109,230
June	25	80,481	25	79,758
May	27	92,323	28	90,108
April	24	73,693	26	88,253
March	46	127,089	47	181,741
February	47	144,273	44	144,508
January	20	69,947	20	72,185
December	23	67,105	21	68,602
November	21	64,277	25	80,084
October	18	50,682	25	82,177
September, 1927	16	51,492	29	83,728

Note: The figures given in this table are for direct entrances and clearances. Additional vessels in foreign trade enter and clear from and to other American ports after original entry and before final departure. At the port of Philadelphia, for instance, additional vessels in the foreign trade in this category were 51 of 174,116 net tons entered and 56 of 189,798 net tons cleared for the month of October.

Direct Drive Diesel Tug



Direct Drive Diesel Tug Harold J. Taggart, for Reading Railroad

THE new Reading railroad tug, HAROLD J. TAGGART is an excellent example of the modern direct drive, reversing diesel engine, harbor tug. The fine general appearance of the tug and the neatness, roominess of the engine room is clearly shown in the accompanying illustrations.

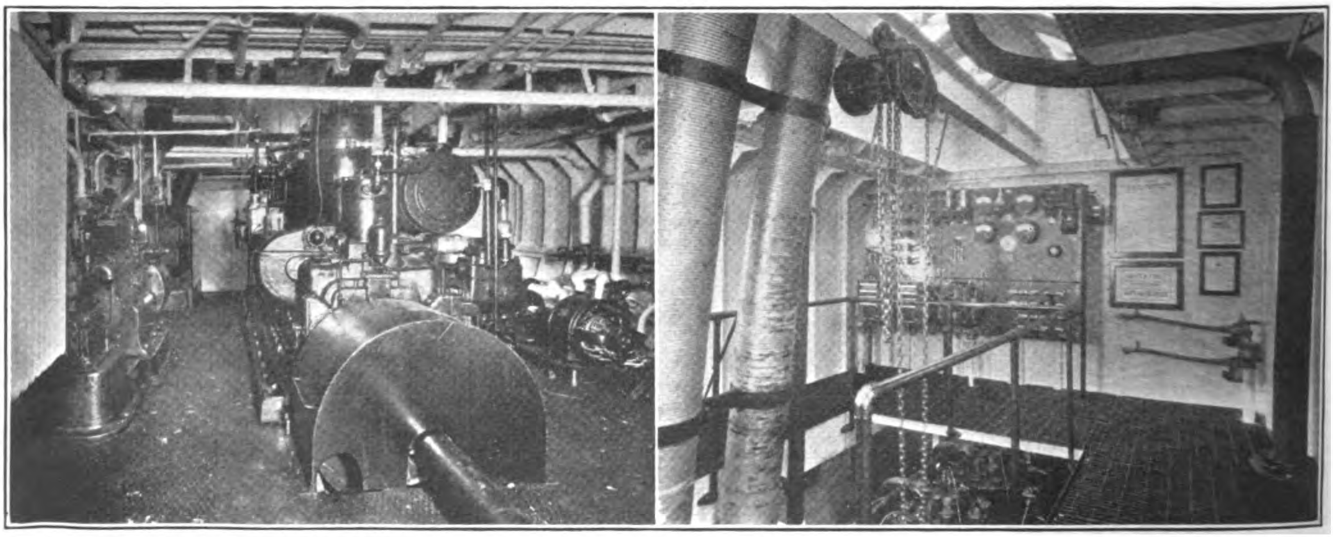
This tug was built by the J. H. Mathis Co., Camden, N. J. The keel was laid April 20 and the launching took place Aug. 15. The length overall is 83 feet; length between perpendiculars 75 feet 4 inches; beam molded, 20 feet; depth molded, 10 feet; and mean draft 8 feet 3 inches. The original design was prepared by the engineering department of the Port Richmond shipping and freight division for the Wilmington and Columbia division of the Reading company. The final design was carried out by Reading Railroad Co. engineers in conjunction with M. C. Furstenau, naval architect for the builder.

The main engine direct connected to the propeller is a 400 horsepower, type CO, Fairbanks, Morse & Co. diesel engine. The stated horsepower is developed at 250 revolutions per minute. The engine, of 2 cycle type, has 6 cylinders 14 inches in diameter and 17 inches stroke. It is directly reversible. A three-bladed propeller of Trout design is fitted. It is 78 inches in diameter and 54 inches in pitch. Auxiliary power is furnished by a 2-cycle, 2-cylinder Fairbanks Morse diesel engine of 27 horsepower at 800 revolutions per minute. This engine is direct connected to an 18-kilowatt 150-volt generator and to an Ingersoll-Rand air compressor.

An auxiliary pump of 500 gallons per minute capacity at 50 pounds pressure, manifolded so that it can be used for fire, ballast tanks and other purposes, was also furnished by Fairbanks, Morse. There is also an interesting tail shaft generator, of 5-kilowatt capacity at 150 volts, driven from the main engine shaft by silent chain of Link-Belt make. The generator itself was furnished by the Safety Car Heating & Lighting Co. It is used normally for supplying lighting, power and for charging batteries. The fresh water system consists of Fairbanks, Morse pumping and compressed air units of 250 gallons per minute capacity. A storage battery, of iron clad type and of 210-ampere hour capacity at 125 volts, was supplied by the Electric Storage Battery Co. There is one 25 gallon per hour Sharples fuel oil centrifuge.

The fuel and lubricating oil pumps are of Viking make. One lubricating oil pump has a capacity of 60 gallons per hour at 1200 revolutions per minute and is driven by a quarter horsepower motor. One fuel oil pump of 300 gallons per hour capacity at 1200 revolutions per minute is driven by a one-third horsepower motor. There is also one hand fuel oil pump geared in the ratio of 2½ to 1. There are three air tanks 30 by 96 inches suitable for a working pressure of 250 pounds per square inch, supplied by Fairbanks, Morse & Co. The steering engine furnished by the American Engineering Co. has an electric driven Hele-Shaw variable stroke pump which operates hydraulic rams direct connected to crosshead on the rudder stock. For heating there is an American Radiator Co. 2000-square foot boiler. Radiators were supplied by the H. B. Smith Co. The galley range, with 30 gallon hot water tank, is of the Shipmate type supplied by Elisha Webb & Co.

An eight person metallic life boat



LOWER AND UPPER ENGINE ROOM OF THE NEW READING RAILROAD DIESEL DIRECT DRIVE TUG HAROLD J. TAGGART

built by Thomas Devine & Son has been installed. The anchor windlass which is electric driven was furnished by the Hyde Windlass Co. and the anchor, of 300 pounds, by the Baldt Anchor Co. There is a Strombos triple siren whistle. For handling such weights on board as may be necessary there is a one-ton low head army type hoist made by the Wright Mfg. Co. An interesting feature is the two 10-inch special diesel type exhaust pipes supplied by the Pennsylvania Metallic Tubing Co. The muffler is made by the builder of the tug, J. H. Mathis Co. Included in other equipment on the tug are; a fuel oil filter of stationary mechanical type; electrical and signaling system; circuit breakers and meters; battery and circuit regulators; and electrical fixtures. The running light telltales were supplied by Charles Cory & Son.

In general appearance and in accommodations this tug is comparable to the most modern railroad harbor type. The anticipated fuel economy will show a considerable saving over a steam tug of the same power. Constant satisfactory performance will furnish additional practical proof of the advantages of the diesel engine drive in this class of vessel. In considering the general suitability of the tug for the service it is engaged in account must be taken of its ability to maneuver readily. With a direct reversible diesel engine this is possible.

Hold Mid-West Marine Meeting

HOW inland business can reach the ocean avenues of commerce and develop foreign trade, better export conditions, shipping problems and possibilities of developing the shipbuilding industry were studied and discussed at the eighth annual middle west foreign trade and merchant marine conference held at the Palmer House, Chicago, Nov. 19 and 20. The meeting was opened by Malcolm M. Stewart, Cincinnati, chairman.

More than 200 delegates heard the Jones-White shipping bill described as a forward step in the preservation of the country's trade rules. Gov. Ralph O. Brewster, of Maine, at the dinner session pointed out that the bill is not a subsidy, but was designed by congress to stimulate, if supplemental legislation is passed, the shipbuilding industry that was weakened by the war and its aftermath and other factors.

Edward N. Hurley, president of the Hurley Machine Co., Chicago, and former chairman of the United States shipping board, declared that manufacturers engaged in foreign trade are keenly interested in the transportation of their wares at the lowest possible freight rate consistent with the service rendered.

"International standardization of ocean freight rates (in conference agreement) by a new commodity classification system which will be fair to shippers and yield a reasonable return to world shipping is vital to the industrial success of all nations."

The "court of public opinion" will always be fair if the people are given the facts, Mr. Hurley said in speaking of the present co-operation between government and business.

Shipbuilding as a basis for an adequate merchant marine and as an auxiliary of the United States navy yards was discussed by H. G. Smith, Bethlehem Shipbuilding Corp. and vice president of the National Council of American Shipbuilders.

"The shipping industry is now in a poorer condition than it has been at any time for 35 years. The three last quarterly reports of Lloyd's show that the average gross tonnage of merchant vessels building in the United States for 1928 has been less than 60,000 tons which is below that of any of the principal maritime countries of the world, in fact, only about 2 per cent of the total tonnage of the world now under construction.

Mr. Smith listed as causes of this decline in shipbuilding the following:

"First, reduction of armament conference in 1922, which almost wholly suspended the construction of naval vessels in the United States and left the private shipyards to depend upon commercial work only for their existence.

"The second reason for the depressed condition of the shipbuilding industry is due to the admission to American registry and thus to the coastwise trade, under the Panama canal act of Aug. 24, 1912, and acts amendatory thereto of Aug. 18, 1914, and June 5, 1920, a total of 262 foreign built steel vessels of 921,842 gross tons.

"The third reason for the depressed condition of the shipbuilding industry is the continued existence of the idle shipping board fleet which consists of about 500 vessels. A large number of these vessels is wholly useless to form a part of a permanent American merchant marine, but they will be a menace to new construction until their status is definitely determined. It would be for the best interest of the American merchant marine to have these vessels classified into those of value for further use; those that may be useful in a nonregistered class only, and those that should be scrapped.

"The sentiment of the American people is undoubtedly in favor of an American-owned and an American-built merchant marine. This sentiment was demonstrated at the hearings held in 1926 by the United States shipping board in various cities throughout the United States, and by the report of the board to congress. It was further confirmed by congress when it enacted the Jones-White bill last May, known as the merchant marine act of 1928.

"Some Problems of the Inland Exporter" were taken up by H. G. Moebus, export manager Newport Rolling Mill Co., Newport, Ky.

"The manufacturers of this Middle West are fast becoming convinced of the importance of export trade to the general prosperity of the country," Mr. Moebus said.

"Among some mistakes common to the beginners in export trade is an impatience for quick returns. Some markets that buy large quantities of American products are geographically so small that the execution of one order to the dissatisfaction of a particular buyer will soon spread through every merchant that may have been a potential buyer of the same product. Another mistake which should be avoided, but which is very common among beginners in the export trade, is the lack of sustained effort. It is very essential, after your product has been established in the market, to continue the supplying of material to the market without periods of inactivity.

"Probably the most important problem of the inland exporter in this Middle West is the maintenance of regular, and dependable steamer service from our Gulf ports. The committee under whose auspices this meet-

ing is being held has done wonderful work toward this end, but its work is not yet completed. We need more frequent service to the east coast of South America, and the creating of a condition that will permit the middle west exporter of heavy and highly competitive merchandise to get into several of the Central American markets at rates at least on a par, if not below those enjoyed by our European competitors.

The growth of South Atlantic ports and their relation to middle west trade was outlined by Dr. R. S. MacElwee, commissioner of the Bureau of Port Development, Charleston, S. C.

"The splendid victory of the Jones-White bill, the success of which is largely due to the activities of this committee and especially your secretary, Malcolm M. Stewart, is indication that this part of the United States is well aware of the fact that we must not only have a merchant marine under the American flag on a sound basis, but that these services must not be concentrated in one Atlantic port, as there are very real dangers to the landlocked Middle West in such concentration," said Dr. MacElwee.

"The Midwest, in supporting the Jones-White bill, with its provision to insure essential trade routes and regional representation on the shipping board, etc., supported the policy inaugurated during the war of decentralization of the port traffic of the United States. The development, therefore, of the ports of the South Atlantic and the Gulf, as well as in the North Atlantic, is in the line of progress of national economy in manufacturing.

"The port facilities of the South Atlantic ports are excellent. Municipalities, railroads, private interests, the United States government, all have constructed modern terminals that in the main are superior to the general run of terminals at other older ports. This stands to reason because these terminals are newer and constructed under modern conditions. Give the vessels of the South Atlantic ports a chance to lift your cargo.

Important points in packing for overseas shipping were outlined by Paul L. Grady, secretary of the National Association of Wooden Box manufacturers.

"If I were in the export business, upon receipt of each order before determining upon how it was to be packed, I would look up in my atlas the exact location of the point of destination. I would know the customs regulations of the country to which the goods were bound and the climatic conditions to which they would likely come into contact during their journey. I would study the route over which the goods were to be shipped and in my mind's eye would visualize all of the hazards which the shipment would meet even under somewhat adverse conditions. Then I would build my package to withstand them. In selecting a container, there are at least six important factors the exporter must must keep in mind.

"First, it must be adequate to protect against damage from handling which includes reasonable assurance from puncture; second, it must be of such construction as to discourage pilfering; third, it must offer protection against climatic changes and adverse weather conditions; fourth, its effect upon transportation and insurance costs; fifth, its effect upon the import duties of the country of destination; and sixth, its cost."

Various resolutions were adopted by the conference at this convention which was its eighth annual meeting. A privately owned and privately operated merchant marine was one of the measures earnestly urged by the conference and it was especially recommended that direct or indirect aid be extended by the government to insure the building up of an American merchant marine. The United States shipping board was commended for the constant improvement made in its shipping services. Senators and congressmen from the Middle West were entreated to lend their support to the continued appropriation of funds sufficient to insure the proper maintenance of all American steamship services. Opposition to monopoly was also expressed and consolidation of lines which would tend to concentrate shipping in a few ports was emphatically opposed. Resolutions also stated that shipping lines should be owned and operated by common carriers rather than industrial companies. The attitude of the government toward improvement of inland waterways was earnestly approved.

Cargo Vessel Sold

The Shipping board on Nov. 8, approved the sale of the S. S. NAAMHOK, an oil burning steel cargo vessel of 8727 dead weight tonnage, to the Export Steamship Corp., New York for operation between New York and ports of the Mediterranean and Black seas for the sum of $65,452.50. The sale was made on the same terms and conditions as those applying to the original sale of the American Export lines to the Export Steamship Corp., the purchaser guaranteeing the maintenance of regular sailings.

S. S. Virginia Sea Trials Are Successful

The new turboelectric liner VIRGINIA of the Panama Pacific line, the largest steamship built in America, returned to Newport News the evening of Nov. 18, after an exacting sea trial which lasted 12 hours, according to a wire received at the New York office of the International Mercantile Marine company, owners of the line. Naval and shipbuilding experts observing minutely her diversified tests, expressed the opinion that her performance fully came up to all expectations.

The VIRGINIA left the yards of her builders, the Newport News Shipbuilding and Dry Dock company, the morning of Nov. 18, and was well on her way to sea at sunrise, when she headed southward from Cape Henry for a run of 21 miles, to False Cape buoy, using only the port generator. Rounding the buoy, she returned on her course, using only the starboard generator for full propulsion.

The next feature of the trial was the test calling for full power from both generators, and again she was sent over the course. This was followed by helm tests, backing and stopping tests and the test of anchors, which consists of letting both anchors go at once, and heaving both up together.

Throughout the maneuvers no effort was made for high speed, the object of the sea trial in this regard being solely to develop the vessel's full horsepower.

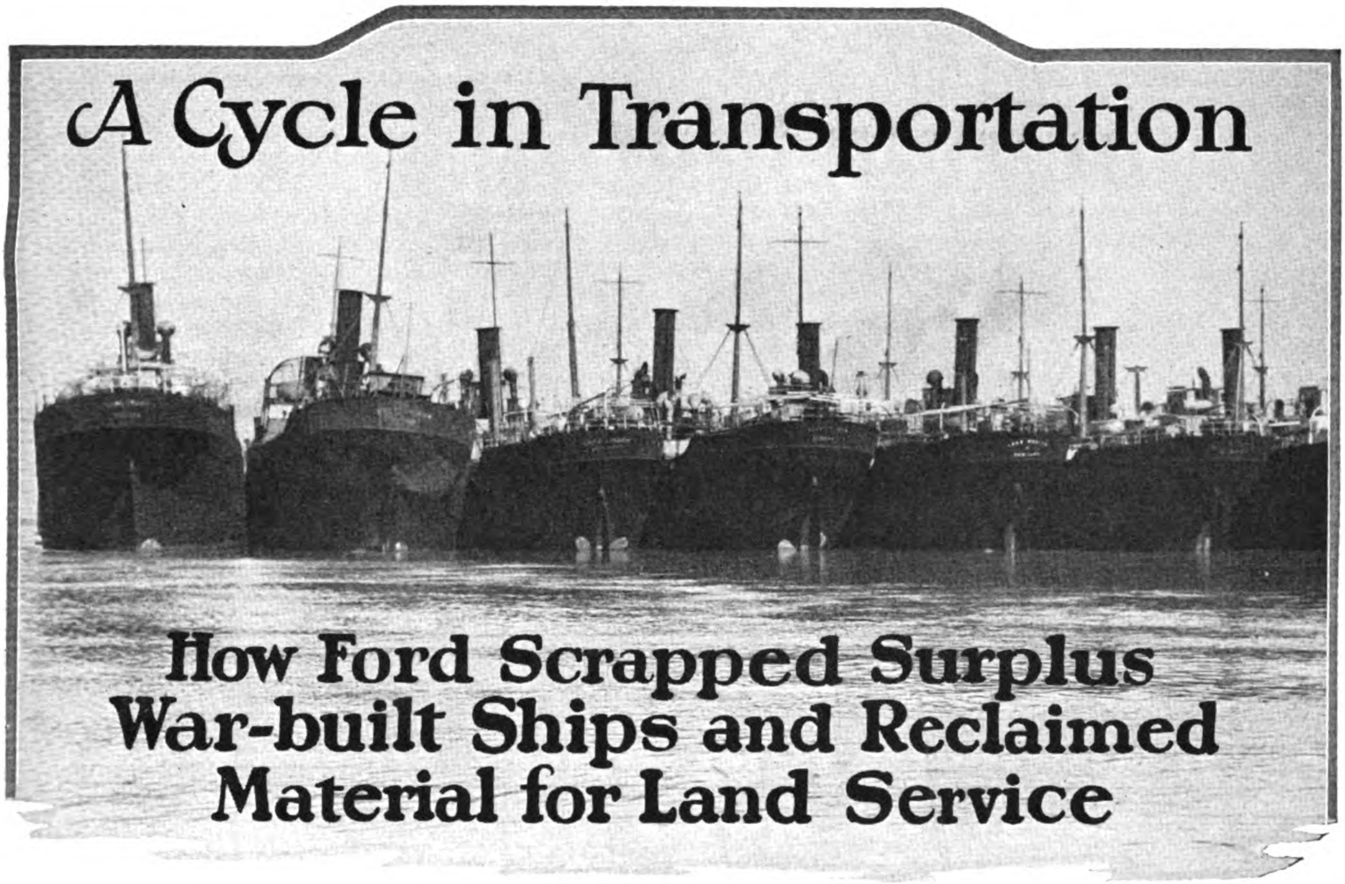
Calibration of the radio compass and adjustment of the magnetic compasses were made soon after clearing the capes.

The VIRGINIA'S performance was fully as satisfactory as that of her sister ship, the CALIFORNIA, showing the same remarkable absence of vibration. She made her contract speed of 18 knots and logged 140 miles.

The VIRGINIA has been delivered to her owners and was expected to arrive in New York on Nov. 28, when outfitting will be completed for the maiden trip between New York and California ports, which is scheduled for Dec. 8.

During the week ending Nov. 17, lake vessels at Cleveland loaded 1,009,610 tons of cargo coal and for the same week last year the docks handled 785,526 tons. Coal shipments for the season to Nov. 19 were 31,591,030 tons compared with 31,825,165 tons for the same period in 1927.

A Cycle in Transportation



How Ford Scrapped Surplus War-built Ships and Reclaimed Material for Land Service

Part V—Marine Boilers and Engines Reconditioned

RECONDITIONING of the marine engines and boilers took place in the Detroit, Toledo & Ironton railroad shops at Fordson. The engines had seen comparatively little service; except for external appearance they were in fairly good condition. Complete overhauling was necessary, however, before they could be put to new uses on land.

An engine to be reconditioned was first completely dismantled; then, part by part, it was cleaned, fitted, tested and reassembled to precision requirements greater even than when originally built. All bearings—crankshaft, main, and connecting rod—were scraped one by one, then sandpapered and refitted. The bearing metal in nearly every case was found in good condition and replacement was seldom necessary. Eccentric straps were scraped and fitted.

The insides of cylinders were cleaned and sanded; cylinder head covers and valve covers were cleaned and repacked; and cylinders were lined up to the crankshaft. Crossheads to cylinders and crankshafts were lined up, as were the slides.

Pistons were overhauled and refitted. Valves were completely overhauled; valve stems were scraped and fitted to brackets; valve stem crosshead bearings were cleaned and fitted; and valves and valve seats were cleaned and scraped. The throttle valve was cleaned and refitted complete.

All drain cocks and drain gear were cleaned and refitted; drain cocks were repiped. Crosshead slides for the cooling system were repiped. Many small parts such as bolts and screws were missing. These were replaced. A new gage board and piping were installed. Steam gages, steam cocks and relief valves were cleaned and tested. Condensers were completely overhauled and in most cases retubed throughout.

FIFTH and concluding installment of the Ford Motor Co.'s own narrative of its scrapping of 199 surplus warbuilt ships bought from the shipping board. Previous instalments appeared in issues of August, September, October and November.

To compensate for the loss of driveshaft and propeller, as originally installed in the ship, it was necessary in adapting a marine engine to land use to install a flywheel weighing about 13½ tons.

A governor was also needed. Existing governors were found inadequate and outside experts consulted declared it would not be possible to design one without redesigning the engine. The problem was given to Ford engineers and they presently designed a new governor capable of controlling the engine's uniformity of speed within one to one-and-a-half cycles at 60 cycles, when attached to a 1000-kilowatt generator.

As a safety precaution the entire frame of the engine was enclosed in a brass casing fitted with glass windows. This not only acted as a safety device but conserved heat and prevented dust and dirt from being admitted to moving parts. The engine was completely relagged and all lag covered with regular Ford plate and nickel straps.

Many of the heavy parts were nickel-plated in accordance with the company's power-house policy. It was necessary in most cases to give all parts a good polish. This required considerable work as the engines were war-built and very little machining had been done on them that had not been absolutely necessary.

A new oiling system was installed with 22 feeds at the top and 22 feeds

at the bottom, to take care of all lubrication automatically, doing away with the necessity for opening doors in the casing and testing bearings for heat.

A gear for attaching an indicator was fitted to each cylinder so that cards might be taken at any time by the man in charge. All gages, steam cocks and relief valves were carefully calibrated and fitted before being installed.

The first step in reconditioning boilers was to remove all scale, both inside and out, particular attention being given to the tubes. The boiler tubes frequently leaked after the scale had been removed, and indications were that water had been left in them during the whole of the time they were laid up. A reamer was used to clean the tubes. It removed all rust and scale down to the bare, clean metal.

Reconditioned boilers were generally used for supplying steam at 175 to 180 pounds. They were therefore tested for 250 pounds on hydrostatic tests and were later given a 200-pound steam pressure test.

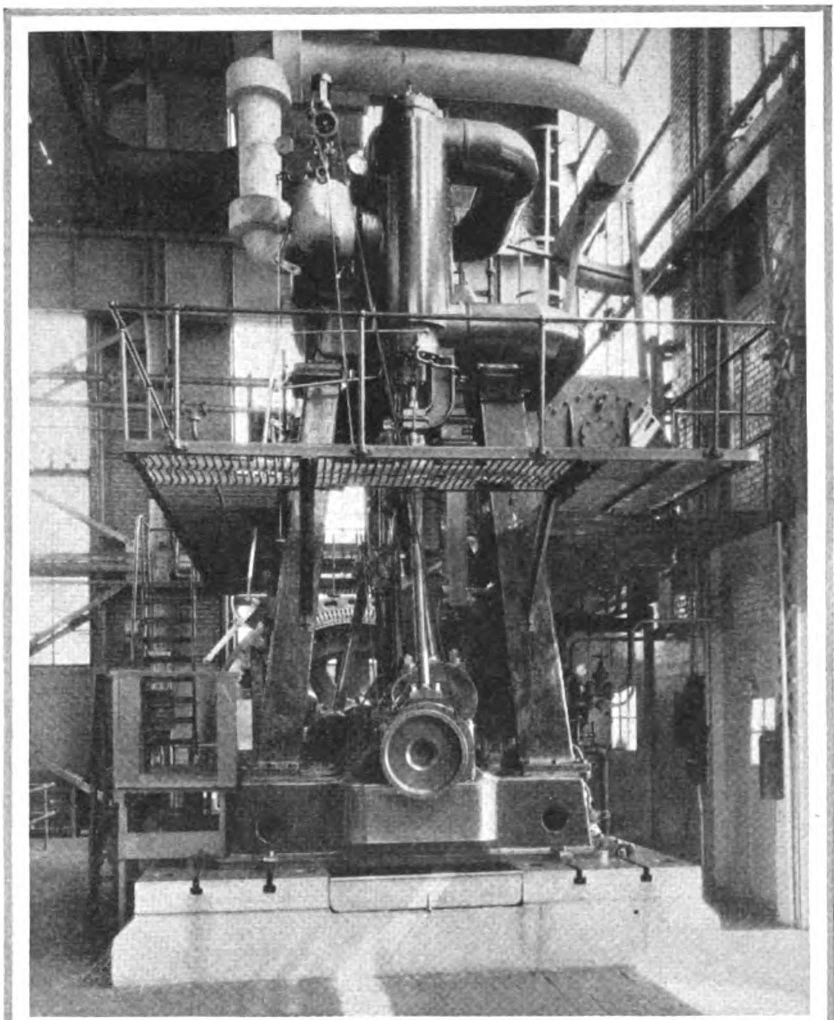
The engines on the lake-type boats ranged from 1000 to 1250 horsepower. The triple-expansion engine on the LAKE FONDULAC, the first to be reconditioned, was impressed to generate power for the coke ovens and by-products building. The engine from the LAKE CONECUS, similar to that of the LAKE FONDULAC, was sent to the plant at Pequaming, Mich. An engine of 1250 horsepower was reconditioned and sent to the plant at Chester, Pa. Another reconditioned engine was installed at the Lincoln Motor Co. plant where it is used as an electrical generator for heating.

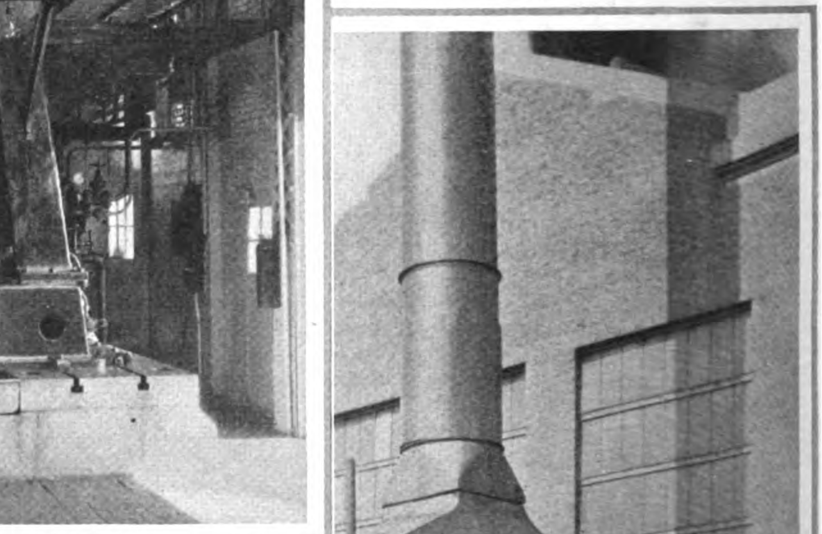
Steel pipe and conduit salvage resulted in the introduction of a new industrial practice: The electric welding of pipe in large quantities. By the end of 1927 more than 800 miles of pipe had been thus reclaimed.

The pipe came from the ships twisted, irregular and corroded; in length the pieces ran from 8 inches to 12 feet. These pieces had to be cleaned, straightened and re-formed to standard lengths. To thread the ends and screw them together with collars would have been slow and expensive and the resulting product would have been cluttered up with fittings.

It was decided to try to weld the piping into the proper lengths. A standard Ford flash welding machine was equipped with a heavy-duty fixture, and experimenting began. The first pipe welded was tested by bending, tensile pull, and hydrostatic pressure.

The tests indicated that, with somewhat heavier fixtures, to withstand the slipping of the pipe under the upset pressure of 2½ tons per square inch, the flash welding method could





Above, the main engine, and below, the boilers of the LAKE FONDULAC, the first ship to be scrapped, set up at the Fordson plant. The boilers have been converted to oil burning, while the engine has been fitted with a specially-designed governor for land service

be successfully utilized to advantage.

It was necessary to find a method of removing the flash which formed during the welding operation on the inside of the pipe, since it closed about one-fourth of the inner area. Experimentation proved that a blast of compressed air, delivered in process, would effectually remove the inner flash, and this method was put into practice. Outside flash was removed with cutter and hammer, and grinder if necessary.

The per-unit current cost ran from less than a half-cent for 1-inch pipe to slightly more than 1½ cents for 8-inch pipe. The time-cost in the first case was 8 seconds, and in the second case, something less than 1½ minutes.

Because of the manner in which it was laid through the ships, pipe came out twisted and irregular. From the dismantling dock it was taken on tractor-drawn trailers to the pipe salvage department. There, in unloading, the job of sorting was taken care of. The pipe ranged from ⅛-inch to 10 inches. It was sorted and stacked according to size, and also to conform to the shop setup.

Much of the pipe was covered with tar and oil. This was removed by the simple expedient of burning.

From the sorting piles a progressive system was followed until the pipe was delivered at the stock department, reconditioned and ready for use. It went first to a battery of ten pipe vises, where it was stripped of fittings: couplings, elbows, tees, etc. Included in this operation was a "flange machine," consisting of a motor, a motor reducer, a revolving clamp and chain tong. The pipe was held by the tong while the revolving clamp unscrewed the flange. The motor reducer was necessary because of the corroded condition of the flange threads.

From the vises the pipe went to the straightening presses. There were ten of these, one large double-action press for pipe 3-inch and larger, and nine smaller ones for pipe ⅛ to 2½-inch in size. Dies for these presses were designed and built by the company.

The LAKE ORMOC *was rebuilt as a base ship for the Ford rubber plantation on the upper Amazon river in South America and sailed in August*

Pipe for the large press was first heated in a gas burner to prevent it from breaking. The burner had three troughs, so shaped that pipe could be placed therein no matter how badly twisted. After it had reached a "cherry heat" the pipe was inserted in the dies while the press stamped it into shape. It was not necessary to heat pipe smaller than 3-inch in size, this being straightened cold in the smaller presses. Forty-five and 90 degree angles being standard, were left in.

After being straightened, pipe with obvious defects or damaged threads was sent to a circular saw where the bad spots were cut out. All ends were squared off, and portions of pipe surface which were to be gripped by the electrodes were ground free of paint. The welding followed.

From the welders the pipe went again to the grinders, where the outside weld was smoothed off. It then went to the threaders, which not only threaded the pipe but reamed it. Three double grinders, one single grinder and six threaders were used in the operation.

Pipe which it was not necessary to weld went directly from the straightening presses to the grinders and threaders. From the threaders all pipe went to a circulating tank where it was washed for 45 minutes in caustic solution to remove corrosion. It was then given the final test, 300 to 400 pounds water-pressure being applied. Following the test an air hose was placed inside the pipe to blow out any remnants of dirt.

The process for reclaiming conduit was virtually the same as that for pipe. Inasmuch as conduit is used exclusively for electrical work, however, and must have a smooth inside surface to prevent insulation from being cut or scraped, no conduit was welded.

Part of the 216,532 *tons of scrap torn from the warbuilt ships*

After being straightened, threaded, reamed and washed in caustic solution, it was scoured on the inside by a revolving wire brush. It was then given a special gage test in addition to the water-pressure one to determine whether the inner circumference was true. The final stage for conduit was to be dipped in a bath of black pipe paint and stored on racks to dry.

Fittings—elbows, tees, nipples, flanges, couplings, and unions—were put through a special reconditioning process of their own. The first operation was to separate those fastened together. This was accomplished with standard easy-outs. After being washed in caustic solution they were scoured by outside and inside buffers—revolving wire brushes operated by a 1½ horsepower motor. Damaged threads were then retapped, and the fittings sent to stock.

Small pieces of pipe were sent to special machines which made them into nipples. Bits from ⅞ to 6 inches in length were utilized in this way. Scrap was sent to the cupola furnace to be remelted. Approximately 18,000 feet of steel pipe and conduit and 6000 fittings were being turned out by the pipe salvage department each working day at the end of 1927.

The ships contained comparatively little lead pipe, and no attempt was made to reclaim it as such. It was cut, rolled into sheets and put to various uses, such as lining acid tanks, etc. Cast-iron pipe which was in satisfactory condition was sent to stock; defective pieces went to the furnaces. Galvanized pipe was also salvaged. Some of it was installed as a brine line at the Lincoln plant. Nearly 25,000 small valves were reclaimed.

The first step in reclaiming copper tubing was to stamp it straight in presses similar to those used on the steel pipe job. It was not necessary, however, to heat any of the tubing before straightening. From the presses it went to a machine which put a point on it, to aid in the subsequent drawing operation.

It then went to the annealing furnace where it was treated and softened. Next came a thorough cleansing in a bath of sulphuric acid. Then it went to the draw bench. There, through a series of dies of Ford construction, it was drawn to desired size, reducing the diameter naturally increasing the length of the tubing. That intended for use as condenser tubes was then put through special rollers as an additional straightening operation.

Copper tubing not suitable for reconditioning as such was made into sheet copper. It was first slit on a band saw, then annealed, straightened, and rolled to a thickness of about 1/32-inch. It was then put through additional rollers for reduction to desired thickness. Wrinkles were taken out by stretching. Filings from the band saw were salvaged through remelting.

Reclaimed copper tubing was used in the distillation plant at Iron Mountain, in the engineering laboratory at Dearborn, in the locomotive shop at Fordson and at many branches. Much of the sheet copper was supplied to the welding department for secondary windings on electric resistance welding machines. Small quantities of brass tubing were reconditioned in the same department.

The policy of the Ford Motor Co. was to utilize every article taken from the dismantled ships. Special surveys were made to determine how equipment originally designed for marine service could be adapted to land use within the company.

Many ingenious methods for utilizing the articles were worked out. All purchase notices for materials even remotely similar to those contained on the ships were carefully scrutinized by special men in the stock and other departments to see whether ship equipment could not be substituted. In nearly 50 per cent of the cases such change could be made. Globe valves, for instance, used principally for marine installations, proved satisfactory substitutes for gate valves.

Signal lights on the bridgeways on Miller road at the Fordson plant came from the boats. Lighting equipment in the tunnel between the pressed steel building and the motors building, in the Detroit, Toledo & Ironton railroad passenger station at Fordson, and in the general stores stock department in the Fordson plant all came from the ships. Hand portable lights made from the shipstock were used in the Detroit, Toledo & Ironton shops. Meters were recalibrated and reconditioned; then put to use on electrical testing jobs.

Ice machines from the fleet were overhauled and put to new duty cooling drinking water at various points in the Fordson plant and at the branches. Searchlights from the ships were used for floodlighting railroad yards at the Fordson plant and for airport illumination.

Electrical fixtures were salvaged from the ships in large quantities. Those of waterproof construction served admirably as vapor-proof equipment in the pyroxylin spray booths in the body department. Switches, conduits and outlets were utilized throughout the company.

Small vertical steam engines and duplex horizontal pumps were used for body finishing work. The former were used as power units for pyroxylin agitators, while the latter functioned as spray pumps. Sixteen of the horizontal pumps were placed in use at the body line at Fordson; others were shipped to plants, branches or subsidiaries in Chester, Pa.; Buffalo; Somerville, Mass.; Charlotte, N. C.; Sao Paulo, Brazil; Yokohama, Japan; Stone, Ky.; Glassmere, Pa.; Highland Park and Dearborn, for supply and other purposes.

Whistles from the ships served as signals at different points in the Fordson plant. They were also used on the company's rebuilt barges. Boiler feed pumps of the vertical simplex type were reconditioned, and assigned to plants as needed, some journeying as far as Yokohama. Condensers and feed water heaters were reconditioned and sent out, after being tested at 300 pounds pressure.

Turbine-driven pumps, having capacities of 2400 gallons per minute each, were altered to motor-driven, and installed at various places. At the open hearth and spring and upset buildings they were used to pump hot oil; at the new administration building at Fordson they were held as storm water emergency equipment.

Small valves of all types totaling 25,000 had been reclaimed and put to use by the early part of 1928. They were sent to the valve repair department at the Fordson plant, reconditioned, repacked, and placed in stock, whence they were requisitioned as needed. Range boilers from the ship galleys were utilized as hot water heaters.

Engine room gratings, ceilings and stairways, found new life in balcony and platform construction. Some were placed in the department of tool supply at Fordson, where a second floor for stock storage was made entirely of standard marine equipment. Deck cabins served as offices, store houses, and tool cribs at the dismantling dock, the ship salvage sawmill, the ore bins, the glass plant, fabricating stock, coke storage, magnesia department, and many other places.

Cork from the refrigeration rooms and life preservers was used for insulating dry kilns and liquor tanks at the Iron Mountain plant, for insulating refrigerators at Ford commissaries, and as pipe insulation. Kitchen ware was replated and used on Ford Motor Co. boats and in plant restaurants.

(Continued on Page 60)

Self Unloading Vessels Needed

Self Contained Units Deliver Cargoes to Any Point Regardless of Dock Equipment—Paid for Discharging as Well as Transportation

By Leathem D. Smith

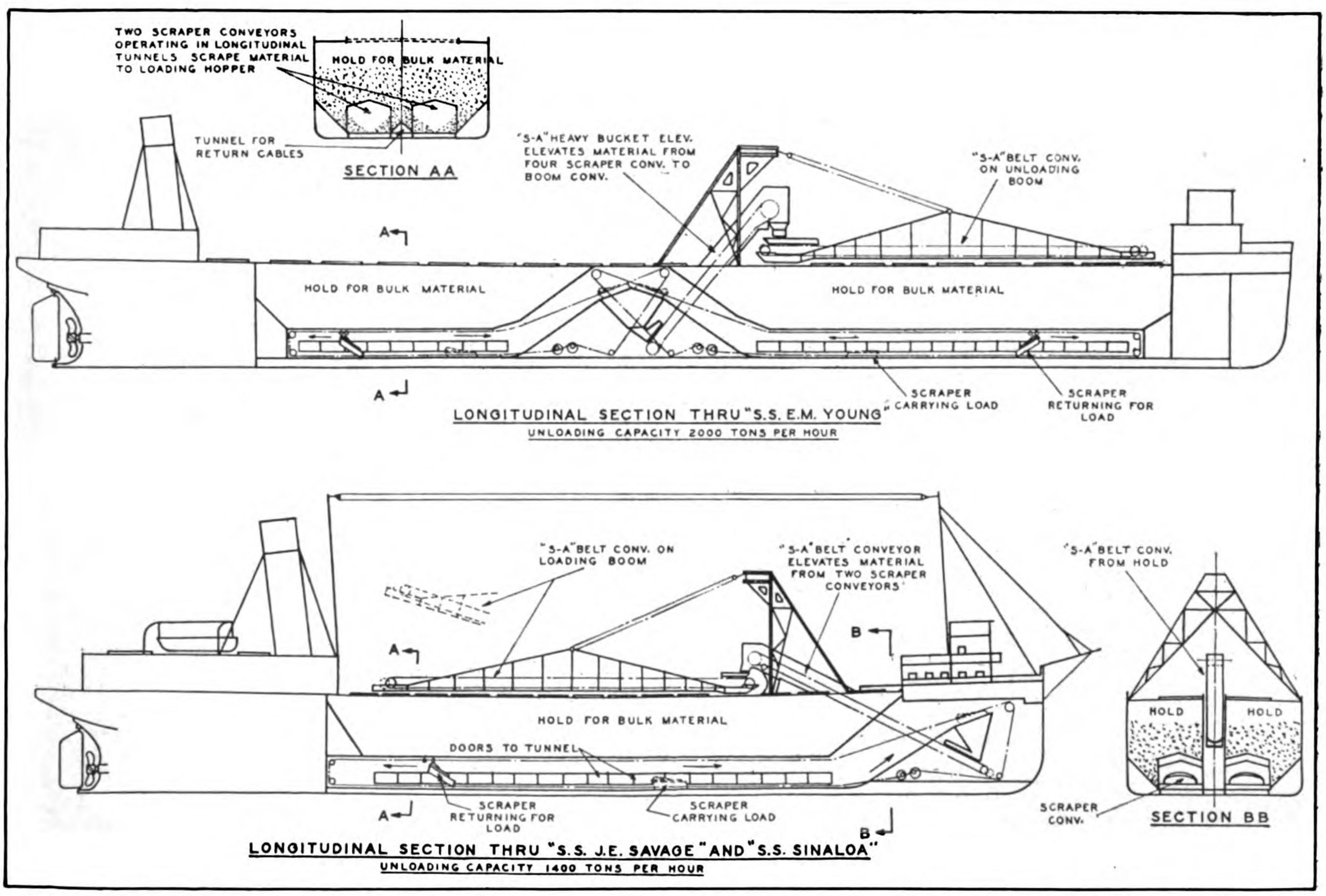
THE primary purpose of the self-unloading vessel is to provide a flexible transportation unit that can deliver material economically and rapidly to any water front point without dependence on or waiting for the operation of shore machinery. Self-unloading freight boats are also found superior for the handling of rough abrasive materials, such as broken stone, etc., which are slower and more expensive to handle, with digger bucket equipment. The use of idle wharfage for the cheap storage of bulk material is also a factor of their usefulness. In every port there is much idle shore front property waiting development which may be leased at low rates for the storage and rehandling of materials.

The saving in the ship's time is also an important factor in the self-unloader boat development, especially in the shorter haul operations where compared to the ship's complete trip a great percentage of the time is spent in port. Take for example, the movement of coal upbound from Lake Erie to the medium size coal docks at Lake Michigan ports. It requires from 24 to 36 hours to unload a six to seven thousand-ton vessel in addition to the delays occasioned by waiting turn at the docks and the loss of time due to no Sunday discharging.

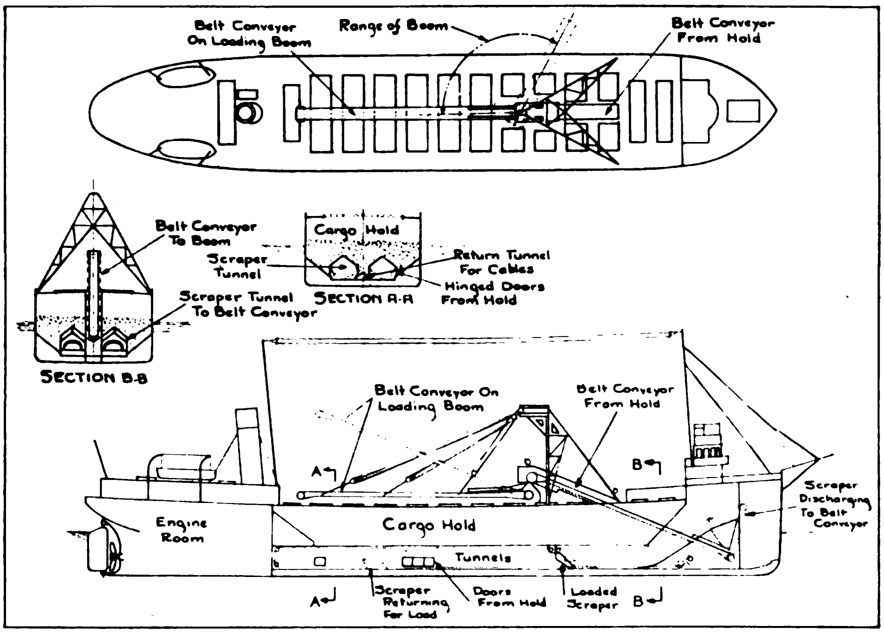
The self-unloader boat discharging a similar cargo from in six to eight hours saves a full 24-hour day over the time of the bulk freighter. The total time consumed on such a coal trip requires two and one-half days of running time, plus the port time. The self-unloader boat by saving 24 hours of port time reduces the total time on the whole operation by almost 30 per cent and in addition is paid extra for the discharging of the materials with a very small increase in operating charge above the bulk freighter. Her choice of down-bound cargoes is also wider than the bulk freighter since broken stone, sand and iron ore may be handled by this equipment.

Another feature of self-unloader boat service is that growing out of its ability to deliver part cargoes at any water front point nearest to the ultimate point of consumption of the materials. Water transportation development in this country has suffered severely in competition with the railroads in spite of higher per ton mile haulage cost on the railroads due to the ability of the railroads to make car lot deliveries at the door of the consumer. The self-unloader vessel with a large number of cargo compartments can approximate this car delivery service by the delivery

The author, Leathem D. Smith is president of the Leathem D. Smith Dock Co., Sturgeon Bay, Wis., and Chicago. The substance of this article was presented as a paper before a recent convention of Stephens-Adamson Mfg. Co. engineers, at Aurora, Ill.



SELF-UNLOADING ARRANGEMENT ON THREE GREAT LA KES VESSELS. ORIGINALLY ORDINARY BULK FREIGHTERS



DIAGRAMMATIC SKETCH OF A SYSTEM OF SELF-UNLOADING BULK FREIGHTER PARTICULARLY DEVELOPED FOR GREAT LAKES SERVICE

of smaller quantities at low water transportation rates to the consumer without the necessity of the consumer supplying equipment to avail himself of the use of water transportation.

While the self-unloader boat is as yet undeveloped for rivers, canals and other inland waterways, it is apparent that there is a broad future for its application in such service. The banks of the rivers and canals present a continuous water frontage along which deliveries can be made nearest to the point of consumption of the material, thereby reducing rehandling and reshipment costs.

There is now being built a shallow draft twin screw diesel engined self-unloading barge designed for operating under low bridge clearances for use on the Chicago river and drainage canal which will demonstrate the possibility of inland waterways usefulness. This barge is also equipped with sand dredging pumps and can produce her own cargoes, by pumping sand and gravel deposits, screening and washing sand, and delivering them in any desired quantity along the water front.

Handling of dredged sand and gravel is another large field for the self-unloading vessel. A boat of this kind equipped with a large dredging pump, either steam-driven or as in the above mentioned vessel, driven direct from the diesel propelling engines, utilizing a system of dewatering boxes, which eliminates the free water of pumping above the deck and permits the wet sand to be loaded in the form of stable cargo into the hold, combined with the rapid discharging feature, gives a very efficient self-contained unit. This unit can be used in place of present equipment which involves either a shore plant or a floating suction dredge, a fleet of a half dozen or more floating barges, one or two tow boats and a number of dock unloading rigs. In addition, this boat is able to deliver her material at a lower cost to docks which have no unloading equipment, or for the servicing of water front construction or the reloading direct into railroad cars or trucks.

This field is as yet undeveloped on inland waterways and seacoast by the self-loading, self-unloading boat method, but it has reached a high state of development on the Great Lakes.

Another general advantage for the installation of the equipment on the ship instead of the docks is the hazard of changes always encountered in the movement of materials. Such changes might render the dock equipment useless due to other and better methods of delivery, or other available sources of supply of the materials. The self-unloading boat being a movable flexible unit is not tied down to the one operation or location and can be shifted without loss into other fields of usefulness. The development of the self-unloader boat on the Great Lakes rapidly replaced the schooner and barge system of delivery, and it has placed the consumers, cities and industries handling small annual tonnages practically on a par as far as transportation and discharging cost is concerned with the large tonnage users of these materials. In this way it is performing a great service to water front customers who heretofore were obtaining little benefit from their proximity to the supposedly low cost water transportation routes.

The self-unloading boat has eliminated the difficulties of the small dock man's operation due to inadequate and intermittently used dock machinery and it saves the labor of stevedoring in unloading. Another advantage of the self-unloading ship is the saving in abuse to the ship's hatch and cargo floor structure.

It is natural that there should be some question about the cost of maintenance of the self-unloading equipment. In practice it has been found from actual experience that unloading rigs properly built and designed will on the average not cost any more for maintenance, in spite of the fact that they are doing all the unloading, than the abuse to the ship's hatch coamings and cargo floor or tank tops caused by the constant pounding of the shore digger equipment. If in addition to the abuse to the vessel, the maintenance on the digger buckets and shore equipment were added, the self-unloader method requires much less for maintenance due to the handling of cargo. Ships' tank tops in the iron ore and coal bulk trade on the Great Lakes must be renewed, after 15 to 20 years or less of use, at a cost of from $50,000 to $80,000. Besides there is a constant annual repair charge to keep these tank tops in the watertight condition required by insurance.

Like all other labor-saving operations, the self-unloader boat has reduced the cost of basic commodities to the consumer and has saved arduous back breaking toil, thereby justifying its existence in raising the standards of living of our people.

Our particular system, which is known as the subcargo scraper method, patented by the writer, has been installed on 12 vessels in the last five years, ranging from 2000 to 9000 tons in size with unloading capacities from 400 to 2000 tons per hour. It is being used for the handling of broken stone, sand, gravel, coal, ores, phosphates, sulphur and gypsum rock, and one vessel completed last winter is fitted to handle bulk cement in addition to the above named cargoes. The diesel engine boat now being built is the thirteenth vessel of this type. Ten of the others were equipped on the Great Lakes, one in Montreal and one in Newcastle, England.

Briefly, the particular type of unloading arrangement referred to consists of two longitudinal tunnels built into the bottom of the regular

hold, with a drag scraper operating forward and backward in each tunnel. The tops of the tunnels, the space between tunnels and the sides of the hold, are hoppered enough to make them self-cleaning. Hinged doors along both sides of each tunnel can be released, permitting the cargo to gravitate into the tunnels.

The scraper in each tunnel operates on a system of cables. When the scoop is being pulled backward, the rear is lifted, causing it to ride over the material which has fallen through the sides. As the scoop is pulled forward, it digs down, pushing the material forward on the smooth steel floor until it is discharged on an inclined belt conveyor in the front of the boat. As the material in the tunnel is scraped forward, new material slides into the tunnel ready for the next trip of the scoop.

The inclined belt conveyor elevates and discharges the material on the boom belt conveyor on the deck. This conveyor can be swung out over the side of the boat and raised or lowered to discharge over a wide area as may be necessary or convenient.

Overseas Shipments from Great Lakes

By A. L. Frank

INDUSTRIAL expansion goes hand in hand with improved transportation facilities, since the success of any manufacturing program depends on distribution. Competition demands lower prices. In order to obtain them, wider distribution is sought so that production can be increased.

That is precisely the position of the automobile manufacturer today. He is seeking wider distribution, and as a consequence is now actively engaged in marketing his product in practically every country in the world. One of his greatest problems is how to ship automobiles in the most economical manner.

The Studebaker Corporation of America, with a growing export business, is constantly striving to lower shipping costs without sacrifice of time. Two "experiments" in transportation were made by this company in 1928, during which year it enjoyed the largest export business in its history.

Early in the year, the S. S. EBERSTEIN, bound from New York for Hamburg, Germany, completed her maiden voyage with a cargo of 500 unboxed automobiles. The practicability of transporting automobiles completely assembled was demonstrated by this shipment. The expense and time necessary to knock down and box cars for shipment and then uncrate and reassemble them at their destination, were eliminated. Since this first shipment, Studebaker and other manufacturers have been exporting assembled cars in increasing numbers.

The second "experiment" was made in May, when the S. S. TRACTOR with a cargo of boxed and unboxed cars, sailed from Detroit, for Barcelona, Spain. Of the two, the latter shipment was undoubtedly the more important. It demonstrated the possibility of shipping boxed or unboxed automobiles from ports on the Great Lakes direct to overseas markets. It pointed to still further reductions in shipping costs through the elimination of practically all inland freight charges.

While the experience with the TRACTOR was entirely satisfactory, and indicated the use of an all-water route

A. L. FRANK

in the future, it revealed many obstacles. With one exception, it is possible for all of these to be corrected.

Chief among the obstacles to all-water shipping are lack of proper loading facilities at ports from which automobiles may be shipped; irregular and infrequent sailings; and lack of properly fitted vessels of sufficient tonnage to make shipping by this route profitable to all. When these conditions have been corrected, a substantial increase in the shipment of cars to overseas markets will be made from Great Lakes ports.

The outstanding advantage of shipping automobiles by this route is the saving that can be effected in transportation charges. Taking all export markets into consideration, an average saving of approximately $25 per car is possible by this method. If a ship, carrying 500 automobiles, could successfully negotiate the various canals and the St. Lawrence river, a saving of around $12,500 in transportation costs would be made on the shipment. In arriving at this figure, all charges incurred in shipping by the all-water route—including pilotage through canals connecting the Lakes, through the St. Lawrence river and through canals in the vicinity of Montreal—have been compared with costs by the present method.

The most serious objections to shipping from the Great Lakes direct to overseas markets now are small vessels and loss of time.

At present, six to seven days is the minimum time between Detroit and Montreal, and from two and one-half to three days are required from Montreal to the Atlantic. This time can be materially reduced when larger and faster boats are placed in service.

In order for vessels of larger tonnage to be placed in service, it will be necessary to wait for the completion of the new Welland canal and the adequate canalization of the St. Lawrence. The canal now restricts movement to vessels having a maximum depth of 13 feet 6 inches. Small ships carrying bulk cargoes are plying between lake ports successfully, but specially fitted vessels capable of carrying approximately 500 cars are needed to make shipping from the Lakes profitable to the manufacturer.

Granted the conditions mentioned are corrected, there remains one obstacle to using the Lakes route, and that is the fact that the Lakes and St. Lawrence river are closed usually from the middle of November until the last few days of April. This

(Continued on Page 64)

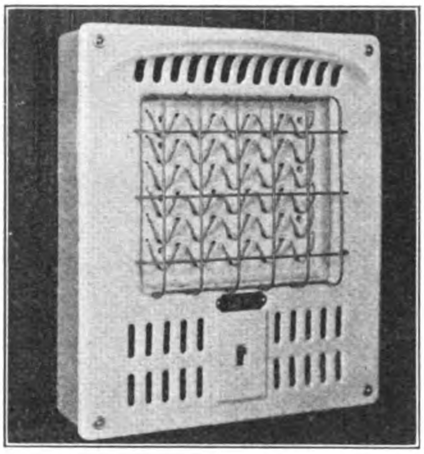
This article was prepared for MARINE REVIEW at the request of the editor. The author, A. L. Frank, is assistant manager of export sales for the Studebaker Corporation of America, South Bend, Ind.

Equipment Used Afloat, Ashore

New Electric Stateroom Heater—Automatic Steam Flow Controller —Flexible Bolt as Pipe Hanger—Full-Floating Flexible Coupling

ALONG with the development of the application of electricity to the propulsion and auxiliary machinery of ships, in the constant striving to increase their safety, economy of operation and the comfort of passengers and crews, has come a perfected electric wall-type heater which combines the two successful methods of heat distribution—convection and radiation. This heater has been produced by the Westinghouse Electric & Manufacturing Co., Pittsburgh.

The wall-type electric heater was designed primarily for installation in the home. However, its acceptance by builders and architects demonstrated that the field for which it could be made adaptable was unlimited, consequently, a similar heater was designed, embodying the same principles of heat distribution but equipped with non-corrosive parts for marine application.



ELECTRIC STATEROOM HEATER

The marine type electric heater consists of a metal box cadmium-plated which can be either mounted flush with or on the surface of the cabin wall, in a porcelain refractory brick heating element that slides into the box, and a white or cream enameled cast iron front frame provided with a monel metal guard over the element. All metal parts with the exception of the element wire which is nichrome are either made of monel metal or brass.

When the switch is turned on the glowing resistance wires throw out a strong beam of heat, warming the area immediately in front of the heater, similar to the heat rays of the sun. At the same time a portion of the heat is conducted through the refractory porcelain brick to an air space that has been provided in back of the element and a draft is started through the heater. As the air in back of the element is heated it rises out through vents in the top of the front frame. Cold air is then drawn in through the bottom vents, and, passing up between the box and the element is heated and forced out the top. In this way circulation is effected and the entire room is heated in a comparatively short time.

This unit is built in any wattage desired from 660 to 3500 and controlled by either a tumbler or 3-heat reciprocating switch.

In order to prevent the currents of hot air from coming in contact with the wall above the heater, a heat shield is placed above the element. This shield deflects the currents of hot air and throws it out into the room. The upper part of the casting extends outward in a lip so that the hot air rising from the heater is forced away from the wall.

It is designed so as not to subject parts in contact with wood or other inflammable material to more than 194 degrees Fahr. which is 400 degrees Fahr. below the point where ignition is possible. Consequently, it is approved by the underwriters.

The initial installation cost of electric heaters is said to be considerably less than steam heat owing to the fact steam heat requires a separate generating plant, long lengths of lagged pipe, drainage valves, etc. In operation, according to the makers, there is also considerable economy in favor of electric heat over steam, especially in those instances where heat is required in only a portion of the staterooms at a time, as the electric energy required to satisfactorily heat several staterooms can be easily taken from the reserve of the generators with the expenditure of very little extra fuel.

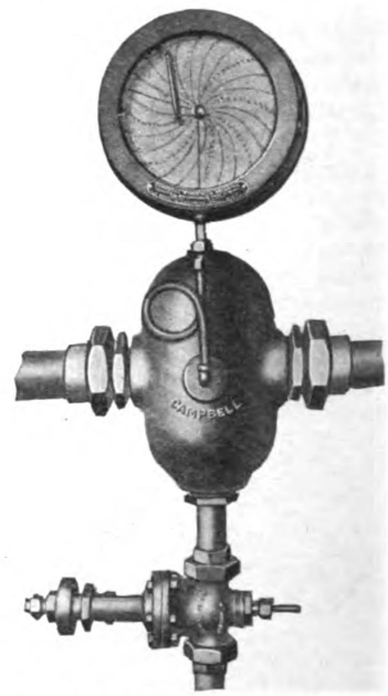
From the important standpoint of weight on board ship, it is claimed by the manufacturers that the heater also affords a great saving over steam or hot water heat inasmuch as the electric heater weighs but 25 pounds while the weight of the necessary wiring is negligible.

The cleanliness, safety and efficiency of the marine electric heater are said to particularly adapt it to modern ship construction and its popularity is evidenced by the growing list of vessels so equipped.

New Automatic Steam Flow Controller

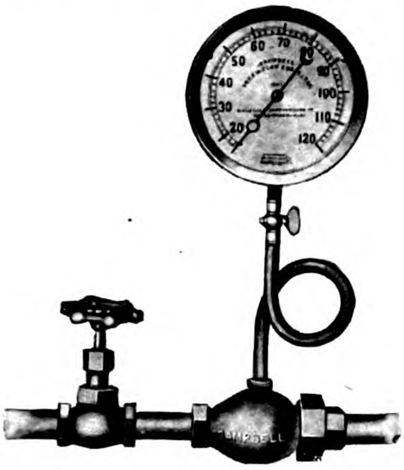
A practical steam flow controller for automatically regulating steam flow has been marketed by the Campbell Engineering Co., Short Hills, N. J. With this device, by means of an automatic or hand-controlled valve, the receiver pressure is regulated until the recorder or indicator shows the desired rate of flow. This controller is said to be in use in a large number of plants. Briefly, it is claimed to do the following things: control steam flow, record steam flow and give direct reading.

This steam flow recorder is said to be a simple and positive device based on a reliable and well known engineering principle. It controls the rate of flow of steam in process work, where it is necessary to deliver steam to low pressure points at constant flow rates. It records and indicates such flow simultaneously. It is scientifically designed to meet the conditions of industrial plants and is said to consistently maintain the flow rate at the point it is adjusted for.



PRESSURE RECORDING INSTRUMENT

According to the manufacturers the controller eliminates guess work. The recorder and indicator both give the flow rate directly in pounds of steam per hour which may be varied as the operator desires. It differs from



STEAM PRESSURE INDICATOR

a meter in that it controls and records steam flow at a desired rate while a meter merely records flow which is controlled by other means.

Essentially, the controller consists of a flexible combination of receiver, calibrated nozzles and recording or indicating instruments. These are rugged, easily installed and easily understood by the operator. Direct savings are said to be made possible in condensing water in fuel and labor. Capacities of pipes and equipment are said to be increased also.

It is claimed by the makers that the accuracy of these instruments under suitable conditions is unquestionable and that the instruments are well within the ability or need of the operator for regulation. The success of the unit is based on the elimination of elements of uncertainty but it is claimed that they effect savings in production costs and in quality of products.

In addition to controlling and recording the admission of steam to process work these controllers are used to regulate steam to gas or oil burners, to distribute and control steam for drying work or for heating purposes, or to regulate steam flow to any point where an appreciable drop in pressure is permissible.

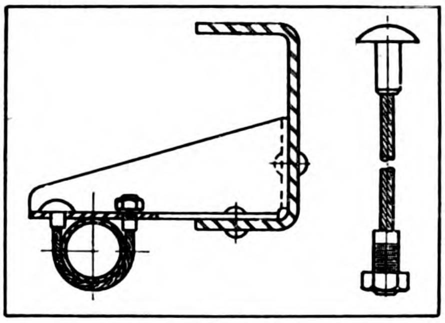
The pumpkin seed type is a single controller having only one receiver and one orifice nozzle. This type is used where relatively small flows are desired as on steam lifts. When proportionate flows to two points are desired two receivers and two orifice nozzles and one recorder may be combined by connection with a common pipe into a double controller.

According to the makers this steam-flow recorder is uniform and interchangeable for all service conditions. It indicates and records the flow of steam in pounds per hour. Where a permanent record of flow of steam is not essential, indicators are furnished which have been designed to match the orifice used. These also are claimed to indicate the flow directly in pounds per hour. If a certain number of pounds pressure per hour is desired, a definite orifice nozzle is used and the control valve is adjusted until the recorder shows the desired rate.

Flexible Bolt Produced for Varied Uses

Through the development of the preformed type of wire rope which makes possible the attachment of fittings by the processing method that compels the fitting to become an integral part of the rope, the American Cable company has recently perfected a flexible bolt illustrated in the accompanying photograph.

These new bolts may be used in



VIEWS OF FLEXIBLE BOLT

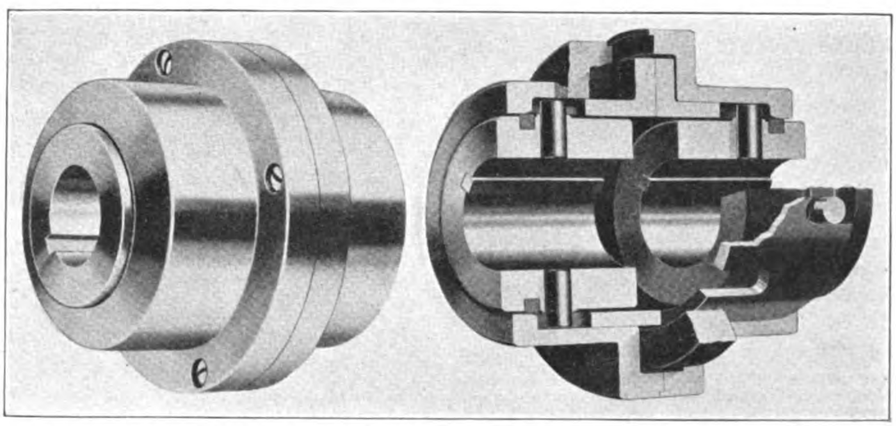
countless places in and around the plant or mill or in any place where rigid U-bolts are impracticable. They are said to be finding ready acceptance as auxiliary hangers for power shafts, suspension brackets, for overhead steam or water piping, shackle bolts for temporary wall boxes, tanks, etc., for scaffolding and tackle, on various parts of machinery, and in other places where semiflexible connections are necessary.

The principle on which the new flexible bolt rests is the preformed type of wire rope. Preforming the wires and strands to the exact helical shape they must assume in the completed rope results in a cable that does not require seizing but may be cut like a rod. This type of rope permits a close fitting attachment to be slipped over the unseized end of the rope and to be processed so that the steel of the fitting cold flows into the interstices of the rope and thus becomes practically an integral part of it. Naturally such fittings can be threaded for a nut or capped for a head. The flexible bolt which has resulted from these developments is available in varying lengths and holds promise of very wide acceptance.

Announces Full-Floating Flexible Coupling

A new type of flexible coupling for use on drive-shafts has been designed by the T. L. Smith Co., Milwaukee.

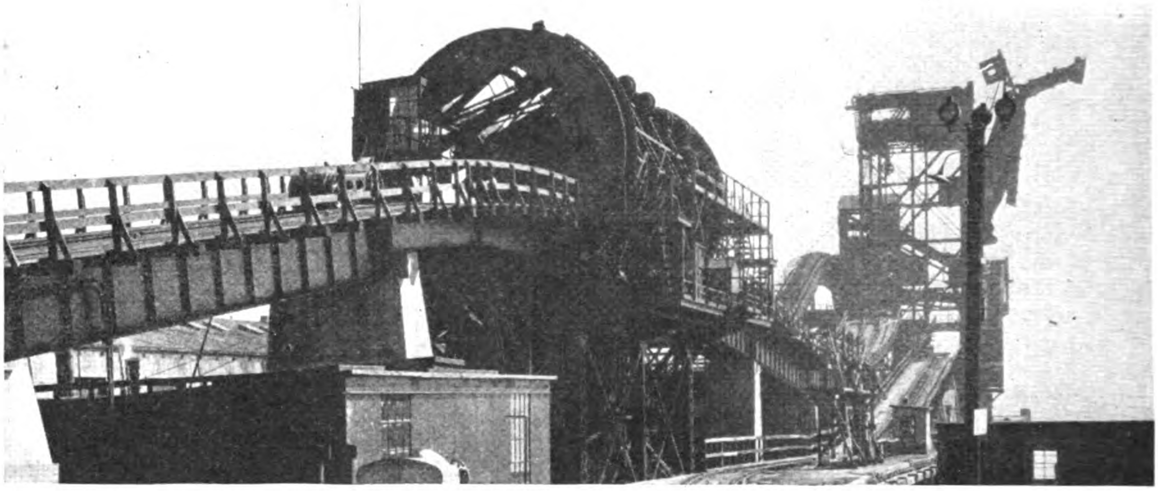
This recently improved style coupling is full-floating and is claimed by the manufacturer to compensate for all possible conditions existing in a direct drive, such as angular misalignment of shafts, offset between shafts, end-play of shafts and shock. The accompanying illustration shows two views of the coupling one of which is a phantom view detailing the interior arrangement. Torsional load is transmitted through one or more ring-shaped springs made of alloy steel. It is said that these springs are not subjected to any wear from endwise motion of the shafts nor from angular or offset misalignment since they are confined in a housing eliminating all motion except opening and closing under stress.



LEFT—FULL-FLOATING FLEXIBLE COUPLING. RIGHT—PHANTOM VIEW OF THE COUPLING

Dock Management Progress Section

How Successful Dock Operators Have Met Problems of Giving Best Service to Ships



Lifting car dumper and recently installed revolving car dumper and conveyor on the Coal Loading Pier of the Western Maryland Railway at its Port Covington terminal, Baltimore

Bulk Material Handling Equipment Reduces Transportation Costs

By F. A. Case

THE scope of this paper does not include the handling of bulk commodities in small capacities, but rather the methods which have resulted in the vast production of today. In the discussion of this subject it is difficult to refrain from reviewing briefly the historical side of the development of modern equipment.

The Great Lakes furnish a marvelous waterway for the transportation of the main bulk commodities, coal, ore and limestone. The source of coal lies adjacent to the southern end of this waterway and the northern end extends into the greater ore deposits in this part of the world. It is logical, therefore, that great fleets of ships have been constructed and equipment of high capacity has been developed to transport the immense tonnages required for modern consumption.

Coal is the only material in this group used for both industrial and domestic purposes. The industrial demand in the districts of Pittsburgh, Youngstown, O., Cleveland and Buffalo is served by rail. Detroit, Chicago and Milwaukee, use considerable industrial and domestic coal but the upper lake region is the center of the vast domestic market and the ports of Lake Superior are the destination of the large shipments from the lower lakes.

This then is the background of our picture—coal cargoes from the lower to the upper lakes and ore cargoes, returning. The first coal cargo was loaded into lake vessels in 1850 at Cleveland from the Mahoning valley by canal boats. This was first unloaded by hand and carried in wheelbarrows to a storage area on the dock, afterward being again handled by wheelbarrows upon the deck of the ship and dumped through the hatch into the boat. The boats at that time had capacities up to 150 to 250 tons and took about a day to load, using all the men advantageously possible.

Mechanical Methods Introduced

It was not long before larger cargoes were carried and mechanical handling methods were installed. This first took the form of revolving derricks designed to handle 1-ton tubs. These tubs were filled by hand and held by a catch which was tripped by pulling a cable attached to a latch. This was between 1875 and 1880. The size of these buckets was subsequently increased to 5 tons by 1892.

Use of revolving derricks was continued until 1890 when the first car

From a paper presented at the national meeting of the A. S. M. E. Materials Handling division, Philadelphia, April 23, 24, 1928. The author is manager of the Ore and Coal division, The Wellman-Seaver-Morgan Co., Cleveland. The photographs used for illustrations were supplied by the company at the request of the editor, through the courtesy of the author.

dumper was placed in operation at the docks of the Cleveland, Canton & Southern railway at Cleveland. This was the Lindsley dumper and was the pioneer. At this time the car capacities were very much less than at present, ranging from 10 to 20 tons. There was a tendency, however, to use larger cars and the old machines proved inadequate. The car dumper art passed through several phases after Lang began to handle cars and developments followed rapidly. In 1896 the first lifting car dumper was put in operation and was immediately successful. Modifications of this dumper are in use today.

The fundamental operation of these machines follows the practice of pushing the cars up an inclined approach by means of a mule car or larry and spotting on the car dumper cradle, which is lifted to a predetermined height when it is inverted and the coal runs into a pan extending over the boat. This pan is contracted at the upper end and a telescope chute is used to direct the coal into the boat. After discharging the coal the car is returned to its upright position and lowered by gravity to the starting point, where it is bumped out of the cradle by the next loaded car coming in. The empty car then runs down the discharge track into the empty storage yard.

Modern machines have been greatly refined but many of the original principles have been retained. All of these original machines were steam operated. The first electrical operation applied to a car dumper for loading boats was at Baltimore in 1921 on the coal pier of the Western Maryland Railway Co. This was followed in 1926 by an electrically operated machine at Toledo, O., on the Ohio Central Railroad Co. dock.

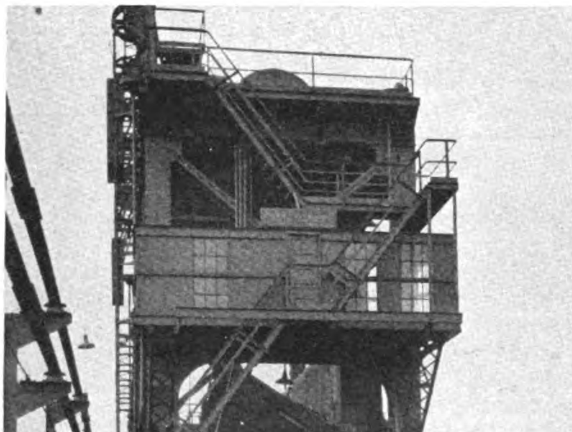
Electrically Operated Car Dumper

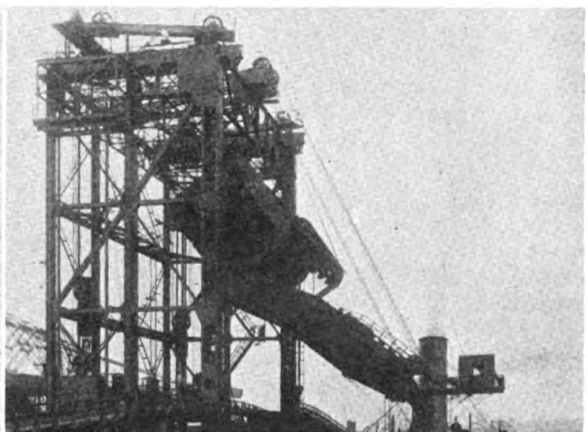
This machine is the most modern of its type and has several unique features. It is the first electrical car dumper of the lifting type ever installed on the Great Lakes. The operation of the mule and cradle motions employs the Ward Leonard principle of generator field control, and the cradle is counterbalanced so that the amount of power required is about the same to raise the loaded car as to lower the empty car after dumping.

The constantly increasing size of cars and capacity demands have required the special feature described. The Toledo machine is designed to handle forty 120-ton cars per hour. These cars when empty weigh 41 tons and loaded 160 net tons. The problem of handling cars of this capacity was solved by applying counterweights in such a manner that the effort acts directly on the cradle to balance part of its dead weight when lifting, and also on the drums which operate the cradle hoist system. The horsepower is thus reduced to about 900 for the cradle hoist as compared to about 1700 horsepower which would be required to obtain the same capacity by previous methods of counterweighting. The mule haulage function of this machine also requires but 900 horsepower. The generator field control also effects considerable saving in current consumption. In fact the total current per ton of coal handled in 70-ton cars during the season of 1927 was only 0.24 kilowatt and this would be considerably reduced if larger capacity cars were handled.

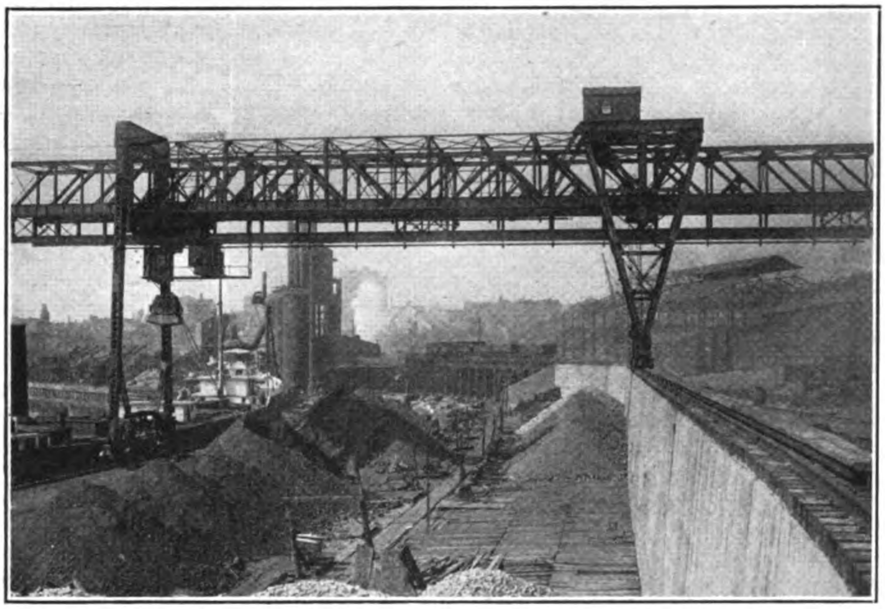
Coal handling on the Great Lakes is an industry in itself but enormous quantities are also handled at Atlantic sea ports. Norfolk, Va., is probably the largest of these. The Norfolk & Western, Chesapeake & Ohio and Virginian have extensive facilities. These differ greatly from the plants on Great Lakes ports, employing simple, turnover car dumpers which empty the material into transfer cars of 100 to 120-ton capacity. These cars are elevated to tracks on the top of huge pier structures with pockets and chutes for discharging into ships. The cars are self propelled and provided with discharge gates at the bottom through which the coal passes into the pier pockets.

On the new pier of the Virginian railway the pier structure differs in that movable loading towers carry the pockets into which the transfer cars discharge and steel conveyors on booms extending over the hatches of





At Left—Movable car dumper of Pittsburgh Crucible Steel Co., Midland, Pa. At Right—Modern lifting car dumper of 120 tons capacity at Toledo & Ohio Central terminal, Toledo, O. Loading vessel—cradle inverted



Man Trolley Ore Handling Bridge—5 tons capacity—Upson Nut Co., Cleveland

the ships carry the coal to a telescope through which it passes into the ships hold.

Baltimore is another port of importance and probably possesses a greater variety of coal handling equipment than any other Atlantic port. The Baltimore & Ohio equipment at Curtis bay consists of two turnover car dumpers which discharge the contents of road cars on belt conveyors which serve movable loading towers provided with shuttle conveyors carried on adjustable booms which may be extended to either side of the pier for loading purposes. The Pennsylvania railroad at Canton is equipped with a single car dumper which discharges into small cable cars traveling on an elevated trestle extending the full length of the pier. These cars are automatically tripped and their load is discharged into the hoppers of movable loading towers similar to those on the Virginian pier.

Large Lifting Car Dumper

At its Port Covington, Baltimore terminal, the Western Maryland railroad has a 100-ton electrically operated lifting car dumper located on the pier in a stationary position and arranged to load directly into boats. Coal may also be diverted through a by-pass chute arrangement and conveyors to a stationary loading tower on the opposite side of the pier.

Recently a new facility has been added by the Western Maryland to their plant. It is noteworthy from the fact that it represents a radical departure from generally accepted methods of handling coal from cars to boats. Cars are introduced into the dumper by the standard mule car method up an approach incline and after being dumped they run down a gravity track to a kickback and into a storage yard. This method is common to practically all loading plants.

The car dumper in this case differs from all others being of the revolving type, that is, it consists of a barrel structure which holds the car and turns about its own axis to dump. On account of the characteristics of this motion it is possible to control the discharge of coal into the hopper beneath the dumper so that there is practically no breakage. The material is removed from the hopper by a steel apron feeder which discharges upon a 60-inch belt conveyor. This carries it to the stationary loading tower where it is taken by the boom conveyor and discharged into the ship. This is the first modern plant to employ the revolving car dumper, although the machine has been very extensively used in power plants and material handling plants remote from waterways. The power requirements are very low, only 125 cradle horsepower being required to handle 45-120-ton cars per hour and the power may be either alternating or direct current.

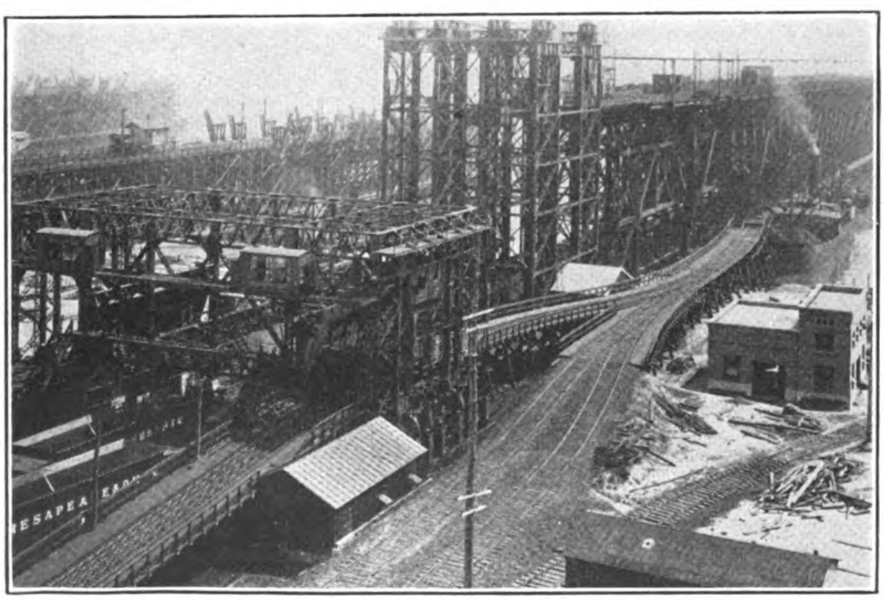
Ideal Coal Loading Plant

This construction included in this latest plant of the Western Maryland railroad is the first step in a revolutionary revision of modern coal loading methods. The ideal plant consists of the mule haulage, the revolving car dumper, and a loading tower with a high capacity conveyor carried by a boom extending over the ship's hatch, and a telescopic chute to conduct the coal into the hold.

Such a plant possesses advantages present in no other arrangement—low initial cost, low operating cost, practical elimination of breakage, low current consumption, low maintenance, absence of massive structures and others less essential. These advantages are so superior that the Pennsylvania railroad after completely investigating all important coal handling plants, to determine the best facilities for their new coal pier at South Philadelphia, selected the revolving car dumper equipment just described.

There are several other important coal loading ports on the Atlantic coast, nearly all of which are provided with the old type of lifting car dumpers. So much for the loading of coal.

The problem of unloading coal from boats on the upper Great Lakes region centers about Duluth and Chicago where unloading bridges equipped with man trolleys handling rope suspended



Car dumper and Tower, Chesapeake and Ohio Railway, Newport News, Va.

grab buckets are extensively used. These bridges span large coal storage areas which are stocked during the navigation season to supply winter demands. The coal from these storages is rehandled by the bridges into screening plants where it is screened and classified for domestic distribution.

Huge Growth of Ore Trade

At the plant of the Canadian Pacific railroad, Fort William, Ont., the coal is taken from the boats by Hulett unloaders and transferred back into storage by bridges. The Hulett machine is primarily an ore unloader and will be described later.

Handling of iron ore from the Lake Superior region dates from 1854. Up to that time the total shipment of ore had come from the Marquette range and the total tonnage was approximately 3000 tons in that year. The shipment of ore continued from the Marquette range until 1877 when 10,400 tons of ore were shipped from the Menominee range. The total yearly tonnage from that time to the present has increased by leaps and bounds until the figure at present is between 65 and 70 million tons per season.

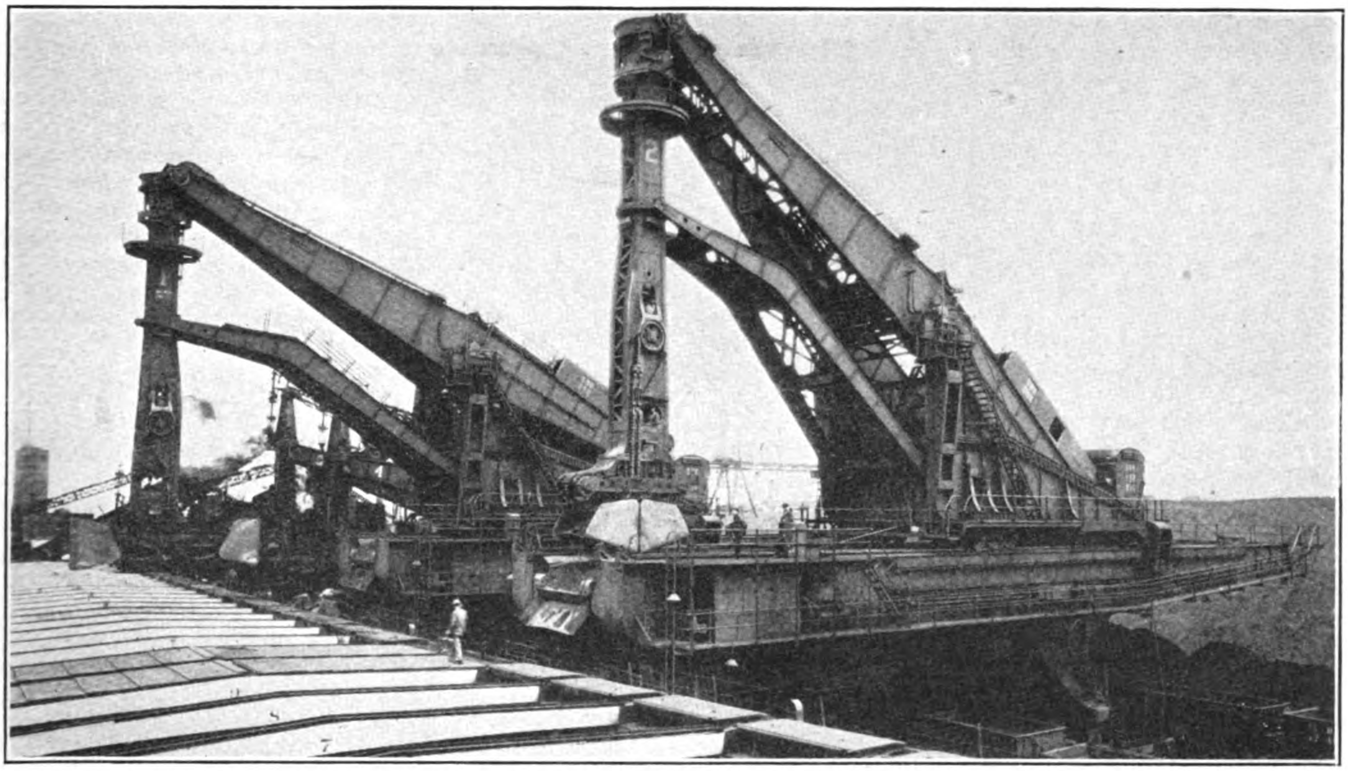
The original handling of this ore was by hand, as in the case of coal, but as the tonnage increased it was necessary to provide mechanical handling methods which followed closely in the footsteps of the development in the coal handling industry. At the present time there are only two accepted methods of removing ore from ships, one being the rope operated grab bucket handled by a suitable bridge or tower structures, and the other the Hulett unloader.

As previously stated, the traffic of coal and ore involves the shipment of coal from the lower lake ports to the upper lakes, and return cargoes of ore are brought down in the same ships. The loading of ore at the upper lake region is essentially different from the loading of coal. At the ore ports of Two Harbors, Duluth, Superior, etc., the ore is loaded at the mines into specially constructed hopper cars which are provided with drop bottom doors. Trains of these cars are brought down to the loading pier where the car doors are opened and the ore is discharged into pockets in the pier which are provided with chutes through which the ore is discharged into the hold of the vessel. On account of the multiplicity of chutes leading from these pockets, it is possible to load a vessel in a very short time as this work is accomplished entirely by gravity. Inasmuch as the breakage is not a factor in the handling of ore, this method described is ideal for transferring from cars to boats.

The removal of the ore from the boats, however, is quite another problem. This has been successfully accomplished by means of grab buckets operated by unloading bridges and also by small unloading towers which have been called fast plants. These, in the majority of cases, are used for unloading boats for direct shipment. When storage of ore is required it has been common practice to use unloading bridges for this purpose, but in the majority of large capacity plants the Hulett unloader has been adopted for the unloading operation.

Ore Unloader Is Efficient

The Hulett unloader was first built in 1898 and at that time was operated by hydraulic power in the main functions, the hydraulic power being supplied by a steam accumulator carried on the walking beam and these machines have been in constant operation up to 1926 when they were dismantled.



Two 15-Ton Hulett Unloaders for discharging Bulk Ore Vessels at the Pittsburgh and Conneaut Dock Co., Conneaut, O.

This machine consists essentially of a traveling gantry framework forming a support for a trolley which travels transversely of the dock. This trolley in turn supports a walking beam, which in the forward position of the trolley extends over the boat. From the outer end of this walking beam a stiff leg is suspended, at the bottom end of which is the bucket operating mechanism and the bucket shells. The descent of the bucket into the boat is by gravity, the forward end of the walking beam being slightly heavier than the rear end. The walking beam is raised by a mechanism at the back end of the

beam which is provided with ropes passing around sheaves at the rear end of the trolley and anchored to the back end of the beam. By slackening off these ropes the bucket is allowed to descend into the boat. The operator for controlling the motions of the bucket, the walking beam and the trolley and in some cases the movement of the total machine along the dock, is located in a station just above the bucket in the bucket log and he travels with the bucket into the hold of the boat where he can see all of the operations of the bucket and accurately control them.

The latest machines of this type have bucket capacities of 17 tons and in some cases the digging power of the bucket will take up 18 or 20 tons. In operation the bucket is lowered into the hold of the boat and closed in the ore. The bucket is then elevated and the trolley runs back to a point just back of the front gantry leg where a receiving hopper is provided into which the bucket dumps. The bucket trolley is then moved forward, the bucket lowered into the hold of the boat and another bucket load is taken up. During the interval that the bucket is getting its second load the receiving hopper is discharged into a larry which travels on an auxiliary track on the underside of the gantry framework. This larry is usually provided with scales and is arranged so that it can be traveled over any of the tracks beneath the gantry span and the ore discharged into the cars after being weighed. In case it is desired to store this ore, the larry travels back of the rear runway and discharges its contents into a temporary storage pile where it can be picked up by a storage bridge and rehandled into the main storage area.

Minimizes Hand Shoveling

In addition to the functions above described, the bucket leg is also capable of swiveling about a vertical axis so that the reach of the bucket is available for cleaning up ore between the hatches. In this way over 95 per cent of the ore cargo can be taken out of a boat without the use of any hand shoveling. This is much in excess of the possibility of any rope suspended grab bucket machine.

Another point of advantage in the Hulett unloader is the fact that the forward end of the walking beam is just enough heavier than the back end to give the bucket proper digging power in the boat. This is about 10,000 pounds. While the rope suspended buckets of this capacity would have a weight of from 30,000 to 35,000 pounds. This results in the case of the Hulett unloader in a very much smaller initial load being applied to the tank top of the boat and consequently the boat damage is very materially decreased. Also on account of the fact that the bucket is accurately guided through the hatch there is no possibility of interference with the upper structure of the boat around the hatches.

The structure of these machines is very heavy and the machines are more or less complicated. The results from their operation, however are fully justified from the fact that while the mass is great the moving load in lifting the bucket is not very much greater than the ore contained in the bucket and the movements are so deliberate without the usual shock found in other types of machines that the maintenance cost is very low. The capacity, however, is almost double that obtainable by any other type of machine. There is a handling record which was made by eight 15-ton machines at Ashtabula, O., where seven boats, having a total capacity of 70,000 tons, were unloaded in 22 hours actual working time, and another record made in June of 1926 where five 17-ton machines at Conneaut, O., unloaded 11,300 tons in two hours and twenty minutes from the steamer JAMES A. FARRELL. This reduced to unity makes a handling record of 970 tons per hour for each machine including all of the cleanup time. There have been instances where these 17-ton machines have unloaded over 1200 tons per hour each.

There are over 50 machines of this type in operation on the Great Lakes and while these are not all of the size described, they represent the progressive stages of the development leading up to the present machine.

Handle Ore After Unloading

After the ore has been unloaded from the vessels at the various plants, it is loaded either directly into cars or from storage into cars, and these cars are transported to the furnace plants where the ore is used. The removal of ore from these cars is usually accomplished by means of our car dumpers which are divided into two classes; the movable class, and the stationary class.

With the movable type of dumper the ore is dumped direct from the car into the storage pile, usually dumping over a retaining wall between the car dumper and the storage. These movable car dumpers are not greatly different from the stationary type except that they are mounted on trucks and the machine is provided with inclined approaches at either end. Cars are introduced into these machines by means of a locomotive and after the car has been dumped, it is pushed out of the machine by the next incoming car and the empty runs out on the discharge track to be subsequently picked up in a train by means of a switching locomotive. These machines, of course, are electrically operated and travel lengthwise of the storage yard so that they can be spotted opposite the point where it is desired to store the particular kind of ore which is being handled.

When the stationary type of dumper is used, the ore is usually dumped into a transfer car which, after receiving its load, travels over a trestle system and discharges from the trestle into the storage yard, or into furnace bins as the case may be. The fundamental principle of these car dumpers is about the same in all cases.

After the ore has been discharged either by demovable car dumper, or by transfer cars, into the storage space, it is rehandled by means of bucket handling bridges into the main storage pile and again rehandled into furnace bins when required or is rehandled for the purpose of shipment when stored in temporary areas.

Postpone Bidding Date

The shipping board recently postponed the date of opening of bids for the sale of the United States lines and American Merchant lines from Nov. 15, 1928 to Jan. 15, 1929.

It is the determination of the board to secure the best bids possible and to afford all interested American citizens adequate opportunity to make financial arrangements and, particularly, plans for new construction. It has been found that opening the bids at the date originally fixed would not accomplish the purpose the board has in mind.

It is the firm opinion of the shipping board that satisfactory bids will be submitted, and with these lines comprising the largest potential sale and with the provisions of the Merchant Marine act of 1928 only in their early operation, American citizens will be afforded ample time to make the necessary plans and financial arrangements in order to submit detailed proposals. The extension of date is agreeable to practically the entire American shipping market.

The tug SUSAN A. MORAN, that veteran open-water tow boat of the Moran Towing & Transportation Co. Inc., New York, sailed from Norfolk on Oct. 22 for New Orleans.

From New Orleans the SUSAN A. MORAN will complete a towage of some newly constructed river equipment to Cartagena, Columbia.

Late Flashes On Marine Disasters

Brief Summaries of Recent Maritime Casualties— A Record of Collisions, Wrecks, Fires and Losses

Name	Date	Nature	Place	Damage Resulting
A. B. King	Aug. 14	Ashore	Harbor Beach	Not stated
Athelbeach	Aug. 12	Aground	Philadelphia	Floated
Annavore	Aug. 14	Fire	River Thames	No. 2 hold
Athena	Aug. 11	Sank	Off Cape North	
Arlington	Aug. 17	Disabled	Providence	Engine
Amassia	Aug. 23	Ashore	Cape Haytien	Floated
Australien	Aug. 24	Collision	Panama Canal	Plates
Alcyon	Aug. 2	Aground	Ranea Skargard	Leaking — floated
Alaska	Aug. 2	Collision	Wapping	Port quarter
Aid	Aug. 2	Collision	Millwall	Sank
Albion	Aug. 5	Disabled	Flushing	Frames — leaking
Amaho Maru	Aug. 3	Ashore	Kyojiyo	Not stated
Anglo Norse	Aug. 27	Disabled	Barry	Machinery
Artena	Aug. 4	Collision	Lake St. Peter	Not stated
Adriana	Aug. 13	Disabled	Lisbon	Machinery
Andreas	Aug. 21	Collision	Hamburg	Stem
Admiral Fiske	Sept. 2	Collision	So. of Tatoosh	Damaged
Arthur W. Sewall	Sept. 11	Aground	False Hook	Floated
Angelos L.	Aug. 22	Bad weather	Rosario	Lost prop.
Alaska	Sept. 9	Disabled	Balboa	Tail shaft
Brightie	Aug. 8	Sank	Lake Michigan	
Bute	Aug. 7	Sank	Northfleet	
Balto	Aug. 12	Collision	Off Kronstadt	Not stated
Braga	Aug. 20	Ashore	Aalesund	Floated — leaking
Bamborough	Aug. 22	Aground	Redcar	Floated
Bamle	Aug. 29	Capsized	Stavanger	Total loss
Brentwood	Aug. 30	Stranded	River Tees	Not stated
Bamburgh	Aug. 30	Collision	Woolwich Reach	Stern
Bracondale	Aug. 30	Not stated	Stockholm	Forepeak, amidships
Bessie Wilson	Sept. 12	Ashore	Pass Island	Not stated
City of Montreal	Aug. 15	Ashore	Morrisburg	Floated
Charles M. Struven	Aug. 15	Disabled	New York	Not stated
Chaplain	Aug. 15	Ashore	North Brothers Isl.	Not stated
Chautauqua	Aug. 17	Ashore	Silver Bank	Total loss
Castilian Prince	Aug. 21	Disabled	Montevideo	Machinery; engine
Chester W. Chapin	Aug. 29	Collision	Off Hell Gate	Not stated
Charlotte	Aug. 8	Collided dock wall	Canning River	Bow
Chikugo Maru .	Aug. 15	Collision	Tientsin	Damaged
Corland	Aug. 17	Collision	Off Rosherville	Not stated
Colmar	Aug. 19	Disabled	Antwerp	Engine
City of Yokohama	Aug. 31	Struck log	Savannah	Engine
Cumberland Coast	Aug. 23	Fire	Ramsey	Fore hold
Calmar	Sept. 4	Collision	Off Point Arena	Amidships
Canadian Rover	Sept. 4	Collision	Off Point Arena	Bow
Commercial Navigator	Sept. 2	Ashore	Off Carteret	Floated — leaking
City of Columbus	Sept. 10	Fire	Boston	Not stated
Castletown	Aug. 21	Collided whf.	San Francisco	Damaged
Capella	Aug. 30	Aground	Kotka	Not stated
Dauntless	Aug. 18	Aground	Halifax	Floated
Dorothy	Aug. 18	Ashore	Kidstone Island	Floated
Daphne	Aug. 25	Collision	Off Dungeness	Sank
Delfin Amitre	Aug. 11	Struck bank	Buenos Ayres	Rudder
Dolly	Aug. 14	Ashore	London	Not stated
Dagfin	Aug. 24	Ashore	Bridgewater, NS	Floated
De La Salle	Sept. 10	Disabled	Havre	Lost prop.
Deauville	Aug. 29	Collision	Havre	Damaged
Esther Melbourne	Aug. 15	Stranded	Nr. Miragoane	Not stated
Ecuador	Aug. 16	Ashore	Nr. Cape San Lazarus	Rudder
Eddie	Aug. 13	Aground	Annalong	Not stated
Elisabetha	Aug. 10	Collision	Newcastle-on-Tyne	Not stated
Erda	Aug. 16	Fire	Genoa	Not stated
E. Rose	Aug. 28	Ashore	Lowestoft	Not stated
Frank W. Wilkington	Aug. 30	Collision	Off Chatham	Damaged
Flamma	Aug. 17	Collision	Newcastle-on-Tyne	Not stated
Floridian	Sept. 2	Collision	So. of Tatoosh	Sank
Gustav Vigeland	Aug. 15	Collision	Delaware River	Damaged
Greylock	Aug. 20	Stranded	Nr. Vancouver	Floated
Gustav Schindler	Aug. 28	Sank	Off Nigeria	
Glenluss	Aug. 4	Aground	Buenos Ayres	Floated
Grelstone	Aug. 9	Collision	Calcutta	Bows
Gleam of Hope	Aug. 13	Explosion	Off Tiumpan Hd.	Sank
Grossherzogin Elisabeth	Aug. 21	Fire	Hamburg	Considerable
Gordon L. O. 382	Aug. 25	Collision	Blyth Sand	Considerable
Hahira	Aug. 15	Collision	Delaware River	Port side
Horace A. Allen	Aug. 12	Sank	Off Atlantic City	
Harry A. McLennan	Aug. 15	Disabled	lat. 38:36N; long. 74:04W	Rudder
Henry Cort	Aug. 29	Ashore	Colchester Reef	Badly—floated
Humber Arm	Aug. 18	Struck pier	New Orleans	Bow
Hsinhsutung	Aug. 14	Sank	Upper Yangtsze	
Henry	Aug. 16	Ashore	Nr. Mbour	Total loss
Harvest	Aug. 23	Stranded	Dalbeattie	Not stated
Heworth	Aug. 23	Aground	Off Karloe	Leaking
Heathfield	Aug. 27	Collision	Barry	Bow plates
Henry Tinnoth	Aug. 29	Collision	Off Tilbury	Stern

Name	Date	Nature	Place	Damage Resulting
Innerton	Aug. 15	Aground	St. Lawrence River	Floated
Iossifoglu	Aug. 24	Ashore	Victoria, B. C.	Not stated
Jay C. Morse	Aug. 12	Ashore	Minneapolis	Floated
John L. Martino	Aug. 13	Aground	Georgetown, S. C.	Floated
Joun Maru	Aug. 11	Struck rocks	Yangtsze River	Sank
Josey	Sept. 1	Fire	Off Cabimas	Damaged
Katherine May	Aug. 14	Disabled	Off Little Hope	Leaking badly
Kalyan	Aug. 6	Fire	Shanghai	No. 3 hold
Kazembe	Aug. 3	Fire	South Shields	Considerably
Konsul Schulte	Aug. 20	Disabled	Hamburg	Steering gr.
Karolos	Aug. 27	Disabled	Barry	Machinery
Kenly	Aug. 27	Ashore on rks.	Off Porthcawl	Sank
Kommandoren	Aug. 26	Aground	Opdalseidet	Not stated
Lovaas	Aug. 9	Collision	Gravesend	Port side
Llanberis	Aug. 14	Fire	Hamburg	No. 5 hold
Livadia	Aug. 21	Collision	Rotterdam	Bulwarks
Labrador	Aug. 23	Ashore	Maldonado	Damaged
Liberal	Aug. 24	Struck sub. obj.	Limpopo Bar	Propeller
Lincoln	Sept. 10	Collision	Off Cape Cod	Port side
Munamar	Aug. 13	Ashore	Nr. Abaco	Floated
Maybrook	Aug. 14	Sank	Newton Creek	
Mary F. Ruth	Aug. 15	Fire	Isaacs Harbor, NS	To water's edge
Miraflores	Aug. 17	Aground	Maullin River	Not stated
Maweema	Aug. 21	Ashore	St. George Island	Total loss
Mifune Maru	Aug. 13	Aground	Notorocake	Not stated
Marie Schroeder	Aug. 15	Ashore	Pentland Firth	Forward; propeller
Misaki Maru No. 5	Aug. 17	Stranded	Nr. Pinacle Island	Total loss
Monaleen	Aug. 21	Ashore	Alnmouth Rocks	Not stated
Martha	Sept. 5	Aground	Stag Island	Floated
Meropi	Aug. 27	Collision	Barry	Damaged
Nelson	Aug. 6	Collision	London	Sank
New Londoner	Aug. 10	Collision	Newcastle-on-Tyne	Not stated
Neptune	Sept. 5	Fire	St. Johns	Considerable
Nickerson	Sept. 5	Sank	Off Nova Scotia	
Orient	Aug. 5	Fire	Dakar	No. 2 hold
Ovre	Aug. 22	Collision	New Orleans	Not stated
Oakhurst	Sept. 7	Sank	New York	
Peshtigo	Aug. 14	Ashore	Harbor Beach	Floated
Passat	Aug. 25	Collision	Off Dungeness	Not stated
Palpetro	Aug. 16	Hvy. weather	Alexandria	Rud. stock
Patria	Aug. 23	Collision	Marseilles	Not stated
Purley Oaks	Aug. 22	Fire	Buenos Ayres	Damaged
Pepita	Aug. 28	Aground	Lima	Considerable
Princess Patricia	Aug. 29	Collision	Vancouver	Bows
Pepeta Maura	Sept. 12	Ashore	Nr. Grady	Not stated
Queen City	Sept. 5	Aground	Stag Island	Floated
Rahman	Aug. 1	Capsized	Bangkok	Upperworks
Robert	Aug. 1	Sank	River Scheldt	
Reina II	Aug. 7	Disabled	Flushing	Machinery
Royal Sovereign	Aug. 16	Collision	London	Stem
Redwood	Aug. 31	Struck reef	Queen Charlotte Sound	Ashore— floated
Robin Adair	Sept. 6	Aground	Portland	Floated
Rottun	Aug. 24	Ashore	Soderhamn	Forepeak
Sagaing	Aug. 9	Collision	Gravesend	Not stated
Sports	Aug. 14	Collided pontoon	Flushing	Bow
Surat	Aug. 17	Collision	Calcutta	Plates
Southern Belle	Aug. 17	Collision	Off Rosherville	Not stated
Shirvan	Aug. 31	Ashore	Nr. Brunsbuttel koog	Floated
Sir Walter Scott	Aug. 17	Collision	Newcastle-on-Tyne	Not stated
Suveric	Sept. 4	Collision	Off Girard Point	Plate
Sui Tai	Aug. 23	Fire	Hong Kong	Considerable
Sierra	Aug. 25	Disabled	San Francisco	Crankshaft; machinery
Sir Francis Drake	Aug. 30	Struck pier hd.	Plymouth	Bows; plates
Shah	Aug. 29	Collision	Poplar	Bows
Thomas H. Wheeler	Aug. 24	Disabled	San Juan	Propeller
Tremeadow	Aug. 4	Aground	Buenos Ayres	Floated
Tsuruga Maru	Aug. 22	Collision	Off German Coast	Bow
Uxbridge	Aug. 5	Sank	London	
Uruguay	Aug. 29	Aground	Parana River	Floated
Villa Rica	Aug. 9	Fire	Off Cabbage Isl.	Total loss
Victor	Aug. 8	Sank	Blackwall	
Veedol	Sept. 4	Collision	Off Girard Point	Plates
W. H. Sawyer	Aug. 14	Ashore	Harbor Beach	Damaged
Wm. A. McKenney	Aug. 14	Hvy. weather	Off Mexican Coast	Superstructure
W. A. McGonagle	Aug. 24	Struck dock	Conneaut	Stem
Whitegate	Aug. 6	Collision	London	Stem
W. C. Richardson	Sept. 3	Collision	Detroit River	Port bow
Whiteway	Aug. 30	Ashore	Off Sandy Point	Sank
West Celeron	Aug. 30	Collision	Woolwich Reach	Not stated
Wahkeena	Aug. 30	Aground	Aberdeen	Damaged
Wellington	Sept. 10	Fire	Lat. 35:11-Long. 75:09	Abandoned
Yves	Aug. 29	Collision	Havre	Damaged

Scrap War Built Ships

(*Continued from Page* 48)

Canvas was used as a protective covering on tractors, and as wind protection on paint spray jobs. Tarpaulin was used as covering wherever suitable. Rubber hose two feet and longer in length was reconditioned; defective pieces were sent to the rubber reclamation department at Highland Park. Hair felt was salvaged for use as covering on cold water systems.

The tops of metal containers were removed and the containers used as waste cans throughout the different plants. Tanks were cleaned, repainted, and used at different plants and branches. Lanterns, lamps, etc., were reconditioned for use by the Detroit, Toledo & Ironton railroad.

Cushions and seat-backs were sent to Highland Park where they were shredded and used in the cushion department. Batteries from the wireless room went to the Highland Park lead foundry where the lead was reclaimed. Pulley blocks were used by the construction department. Hatch covers were used for platforms in the storing of auxiliary machines. All rags were baled and cleaned.

Lockers, plumbing, and lavatory equipment were installed in buildings at the Fordson plant, in the Kentucky and West Virginia coal territory and in the lumber and mining districts of the Upper Michigan peninsula. Boiler blow-down, safety, and checker valves were sent out on orders for installation of boilers to branches throughout the country. Some angle valves were used in reconditioning antique engines in the collection of Mr. Ford.

Forty or fifty vacuum, steam, and compound gages were removed from each ship. They were repaired and rebuilt by the boys of the Henry Ford trade school and placed in stock for distribution. Coolers from condensing units were applied to cooling caustic soda on production jobs or converted into heaters for water and oil. Lufa sponges proved valuable salvage. They were used for filtering purposes.

Magnesia was salvaged from pipe and boiler covering. A small building at the Fordson plant was devoted to its reclamation. It was sorted, wires and other foreign matter were taken out, and it was then ground in a pulverizer to about the consistency of flour. A large suction fan above the pulverizer took care of most of the dust, but men operating the machine wore gas masks as an extra health safeguard.

From the pulverizer the magnesia went to a worm mixer, where a binder, either stucco or silocel, and water were added. Two hundred and fifty pounds of magnesia, 20 pounds of binder and 50 to 20 pounds of water, depending on the moisture in the air, formed the usual batch. The mixture was measured in molds by weight and then stamped into solid blocks on a punch press. These blocks were then put to a variety of uses as pipe, boiler and furnace covering. Asbestos was recovered in a similar manner.

Condenser tubes were reconditioned for use as condensers at the coke ovens. Coil chain was used at Fordson for tractor skid chain. Sheaves were sent to the mines at Stone, Ky., for various uses. Scow cleats went to L'Anse, Mich., for use on boats there.

The LAKE ORMOC, reconditioned at New Orleans in 1925, seemed favored over the 198 other ships. After an eventful career as a towing steamer during the period of the ship movement it was docked at Fordson in the winter of 1927-28 for dieselization and complete renovation to serve as a hospital and base ship for the Ford rubber plantation on the Tapajoz river in Brazil.

This vessel is probably wholly unique among cargo ships. The quarters for officers and crew were enlarged and made really comfortable. There is on the LAKE ORMOC a fully equipped hospital, an especially well fitted laboratory, a complete machine shop, a combined library and lounging room, a laundry, a recreation room for the crew, showers, exceptionally thorough sanitary features and more refrigerating equipment than on any other ship of her size.

The rebuilding was done principally at the dock where all the fleet of sister vessels was dismantled, and it was done by the same men who had been occupied in the scrapping processes. The triple expansion steam engine with which she was originally powered, and the scotch type steam boilers, were removed. Since they were too large to be lifted out through the engine room skylight a portion of the bulkhead to hold No. 2 was removed and the engine and boilers taken out through the hatch over this hold.

A rugged foundation was then built in the engine room and a 1000-horsepower Busch-Sulzer, two-cycle diesel engine was fitted and direct connected to the propeller shaft. In the engine room were also installed two 100-horsepower Worthington diesel engine generating sets. A 100-horsepower electric motor operating from the current so generated was installed for operating a 200-cubic foot per minute air compressor which furnishes air for starting the main and auxiliary diesel engines. A 75-horsepower donkey boiler was fitted to supply steam for operating some of the auxiliary units including the ice machines. Steam is also used for heating and hot water and other purposes.

An especially interesting feature on the LAKE ORMOC is the use of sea water for drinking as well as boiler makeup and sanitary purposes. It is prepared by a distillation plant which has a capacity of 12 tons every 24 hours.

Diesel engine fuel oil is carried in the double bottom tanks and a sufficient quantity can be taken on to operate the ship seven to eight months without refueling.

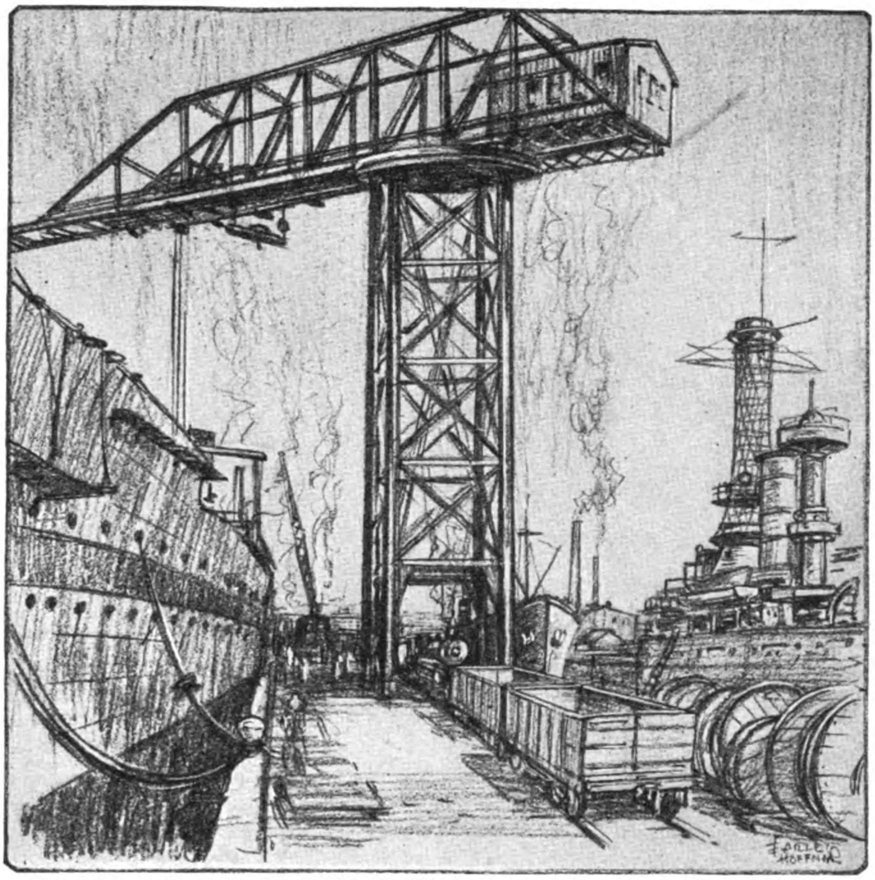
Electricity is generally used on board, the steering gear, cargo winches, and windlass all being electrically operated. Before dieselization the normal crew of the LAKE ORMOC was 34 men. Now with diesel engines for main and auxiliary power she carries under normal conditions only 28 men.

The original quarters for the crew in the after part of the ship were enlarged and altered so as to allow a room for each two men. Additional space is now utilized as a recreation room. Crew showers are located in the new superstructure on the poop deck. This superstructure also contains a hospital with an operating table, two beds and complete surgical and medical equipment. There is also in this space an extra passenger room.

Officers' quarters located amidships were enlarged and accommodations were built for eight passengers. There is a combined lounging room and library for officers and passengers also located amidships. All quarters for officers, passengers and crew were newly furnished throughout.

The laboratory, the machine shop, the laundry and the refrigerating equipment are located on the shelter deck. The laundry serves for both officers and crew.

The LAKE GORIN and the LAKE BENBOW, the two other reconditioned steamers, have been used in intercoastal trade since the end of the ship movement. Five of the ships rebuilt in the winter of 1926-27 have been plying up and down the Great Lakes with coal, iron ore, lumber and other raw materials. Two more ships rebuilt as barges in the winter of 1927-28 are carrying machinery and supplies to the Brazilian rubber project. The tugs, after the ship movement in 1927, have been employed in towing the barges on the Great Lakes.



Need Strong Navy

(*Continued from Page* 22)

curtail and limit future naval competition. With this thought in mind the nations involved agreed on a ratio of capital ships and airplane carriers which later became known as the five, five, three, ratio.

Living Up to Agreement

Under the terms of the agreement each participant listed the number, size and type of vessel it was to possess and use, adopted for defense and combative purposes. To comply with the agreement involved the scrapping of enumerated vessels by each participant; the cancellation of building of certain vessels more or less completed and an abandonment of building programs contemplated by all.

The United States accepted the agreement in full faith. It actually scrapped 19 vessels built and afloat and canceled the building program on 13 vessels under construction. The ships actually scrapped by the United States numbered 32 of 842,380 tons. The ships actually scrapped by Great Britain numbered 19 of 397,250 tons. The ships actually scrapped by Japan numbered 16 of 354,709 tons. France or Italy did not scrap any ships.

By this program the United States scrapped twice the tonnage of any other participant, and more than that, agreed to abandon and did abandon a building program that meant world naval supremacy.

It cannot be denied that under the literal terms of the agreement the program was to determine the ratio of capital ships and airplane carriers. Nor can it be denied that it was the understanding of the United States that capital ship tonnage was to be the yardstick to measure the strength of navies. This rule of measurement was in fact subscribed to, in principle, by all the members of the conference,

That there may be no mistake in America's interpretation of this principle we have the official statement of the naval policy of the United States based on the so called Washington treaty as promulgated by the then secretary of the navy, as heretofore quoted.

This is 1928 and what is the world naval situation today, particularly as viewed by the participants in the conference of 1921-1922?

In other than the United States we find the participants quoting the letter of the bond and stating that outside the types specifically mentioned in the agreement each participant is at liberty to build, maintain and use any and all naval vessels not covered by the disarmament agreement.

The yardstick that was to mean and does mean the lifting of the demands of competition is forgotten, or sacrificed, to meet the viewpoint of what should be an obsolete era and idea.

Americans should remember and never forget that the United States acting in good faith, wholly free from guile, sacrificed as a result of the conference unquestioned world naval supremacy and nearly $400,000,000 in actual and tangible value. Today the building program of our associates, actual and contemplated, necessitates on our part, if we are to maintain the five, five, three, ratio, an expenditure of over $750,000,000.

This means, and the citizens of the United States as a unit should remember, that their contribution to aid the progress of civilization has and will cost them over a billion dollars. Has naval competition ended?

Order Electric Liner

The Grace Steamship Co., Oct. 27, announced that it had placed with the New York Shipbuilding Co. of Camden, N. J., an order for construction of a new 18-knot passenger liner to operate in the Grace line between New York, the Panama canal and ports of Peru and Chile on the west coast of South America. The Grace line during the last six months has already added to the service the new vessels SANTA MARIA and SANTA BARBARA. The new ship now ordered will be delivered late January, 1930.

The new vessel will be 502 feet in length overall, about 64 feet beam, of turbo-electric drive generating 12,000 shaft horsepower with a speed of 18 knots and will carry first class passengers only to the number of 175. Freight capacity will exceed 7000 tons and the vessel will have exceptionally large hatches with a lifting capacity of 75 tons.

New Channel Steel Barge

Contract to construct a steel barge of the Ellis Channel type has been given the Wallace Bridge & Structural Steel Co., Seattle, by Young Bros. Inc., of Honolulu. Work will proceed at once and the vessel is to be ready March 1, when she will be towed to Honolulu by the wood tug MIKIMIKI which the same owners are having built at the plant of the Ballard Marine railway. Both tug and tow will be employed in freighting pineapples to Honolulu.

The steel barge will be 140 feet in length, 40 feet beam and 10 feet in molded depth.

Building Loan Outlook For New Vessels

Sufficient time has not yet elapsed since the enactment of the Merchant Marine act of 1928 to allow an accurate appraisal of the full effect of the beneficial provisions of the law upon the new construction situation. Probably another full year will be required for the full story to be told. At the present writing it is possible only to state the stimulating effect of the law to date and to recognize the factors that will influence the course of events during the next year.

Since the 1928 law became effective, two loans have actually been concluded, namely those to the American Line Steamship Corp. in aid of the construction of the S. S. VIRGINIA and a sister ship as yet unnamed. Four loans have been authorized by board resolution to the Export Steamship Corp., subject to the execution of formal loan agreements, which loans will be used to aid in the construction of four combination passenger and cargo vessels. Construction has actually been started on the two American line ships, and bids for the construction of the four Export ships were opened Nov. 5.

At the present time four other loan projects are in course of negotiation. The policy of the board is to regard all details of new construction projects as confidential until loans are formally approved or until the applicants make the information public of their own accord. It is therefore not possible at this time to give any details of the three projects above referred to. Suffice to say that seven ships are involved.

The projects acted upon and now being considered represent but a fraction of the number expected to be advanced during the next year or two. The postal authorities are carrying out the program of contracts with commendable promptness, and nearly every contract must, by its nature, result in new construction. The ball has started rolling, and is gathering momentum, and there is every indication that another few years will find the American merchant marine equipped with an adequate fleet of modern, efficient ships plying profitably on the essential trade routes built up by the shipping board.

Until Dec. 1, the steamers of the D. & C. line will operate daily between Cleveland and Detroit. The last vessel of the Detroit and Buffalo division will leave Buffalo for Detroit Dec. 3.

Turbine Electric Drive

(*Continued from Page* 33)

is extremely important. The average time for thirty trips in 1927 was 75 hours, carrying an average of 14,450 gross tons, which was unloaded at an average rate of 0.67 gross tons per second.

The largest cargo ever carried on the Great Lakes up to Aug. 1, 1928, was 16,033 gross tons. This was carried by the CARL D. BRADLEY and was unloaded July 27, 1928, at a rate of 1 gross ton per second.

Log Sheets

The readings given in Table 5 are taken from 30 log sheets of the CARL D. BRADLEY during the 1927 operating season. This table gives the time running at full speed, checks, delays, loading and unloading, the miles run, cargo carried, coal used and power delivered by the main generator when under way and power input to the propelling motor. The power delivered by the main generator and input to the propelling motor was taken from integrating watthour meters. It should be remembered that the CARL D. BRADLEY is a self-unloader type of ship and considerable power is required when unloading and, therefore, an expenditure of fuel.

Table 6 is the average of the 30 trips given in Table 5. It should be noted that the average speed was 14.1 miles per hour, 450 pounds of coal per mile, average cargo 14,450 gross tons, average ton-miles per pound of coal 32.3.

Up until September the 1928 season shows 439 pounds of coal per mile and the average ton-miles per pound of coal is 32.58.

Summary

There are at the present time some 30 ships in various services equipped with turbine electric drive, representing a total of over 500,000 shaft horsepower.

The turbine electric drive on the T. W. ROBINSON and CARL D. BRADLEY have proven adaptable in maneuvering and general operation on the Great Lakes.

The low cost of maintenance of turbine electric drive on a Great Lakes cargo ship can only be proven by time, but based on ships operated at sea it is less than a reciprocating steam engine.

The automatic stokers allow the use of slacked coal, with a 20 per cent saving in the cost of fuel, and on the CARL D. BRADLEY have eliminated six firemen.

The tests conducted on the water-tube boilers, using stokers, indicate that this type of boiler is as efficient if not more efficient than the hand-fired Scotch boiler.

The CARL D. BRADLEY requires between 1.15 and 1.2 pounds of coal per shaft horsepower hour for all purposes when running under a constant steaming condition, against 1.65 to 2.25 pounds per shaft horsepower hour for the reciprocating steam engine as operated on the Great Lakes. The overall coal consumption for 30 trips in 1927 on the CARL D. BRADLEY, which is a self-unloader, including all coal used when loading, unloading, delayed, etc., was 1.39 pounds per shaft horsepower. This is equivalent on a cost basis, using slacked coal, to 0.47 pound of diesel oil per shaft horsepower for all purposes, including all fuel used loading, unloading, delayed, under way, etc.

The average gross ton-miles per pound of coal as fired for 30 trips in 1927 was 32.2.

The average gross ton-miles per pound of coal as fired up to September, 1928, is 32.58.

Bronze Shaft Sleeves for Marine Use

Products manufactured by the Paper and Textile Machinery Co., Sandusky, O., demonstrate how greatly diversified are the manufacturing interests of this country. This company, as indicated by its title, serves primarily the paper and textile industries, but in addition produces and markets a great deal of equipment used in shipyards for the construction of vessels. According to the latest booklet published by the company, the United States navy and the United States Shipping board have been and are regular customers.

It is pointed out in the booklet that the special marine requirements of the largest shipyards on the Atlantic, Gulf and some on the Pacific coast, in bronze sleeves for tailshafts etc., are supplied by the Paper and Textile Machinery Co. The company's standard composition has been indorsed by the American bureau of shipping. Lloyd's and the Bureau Veritas accept the company's fluid-compressed sleeves on the basis of surface inspection.

These sleeves, are used on propeller shafting, in stern tube bushing, rudder posts, as marine pump cylinder liners and as periscope tubes. They are manufactured from metals selected to meet the most severe demands of various services, and are required to meet rigid tests and inspections.

Overseas from Lakes

(*Continued from Page* 51)

means that the all-water route can only be used for transportation about seven months in the year.

Even with the route open only part of the year, there is every indication that the next development in transportation to overseas markets will be over the all-water route. Studebaker's experience with the TRACTOR demonstrated it to be feasible, although not practicable on a large scale under existing conditions. When facilities are improved so that a large volume can be handled expeditiously as well as economically, there is little doubt that shipping from the Great Lakes direct to world markets will be employed by many manufacturers.

Lake CaptainDies

Capt. Richard O'Connor who had sailed the Great Lakes for approximately 50 years, and who had held various responsible positions both as an operator and owner, died in Detroit, Saturday Oct. 13.

Born at Harder's Hill on the shores of Lake Huron, Feb. 10, 1858, he moved during early childhood to Marine City. At the age of 15 his life as a sailor began, starting as cabin boy on the steamer BAY CITY, Remaining with this vessel for seventeen years, he gradually became its master and part owner. Following the vessel's destruction by fire in the Detroit river, he sailed various Great Lakes vessels which included carriers of the Mark Hanna Co. Several years later he became associated with the John and Alfred Mitchell Co., and remained in its service for 18 years. During the years of 1924-25, he acted in the capacity of relief master, substituting for captains who were absent on account of illness or for some other reason. At the close of 1926 illness caused his final retirement.

Capt. O'Connor was one of the oldest members of the International Shipmaster's association and held the office of chaplain for several years during his active life.

Loading Draft Reduced

Notices have been issued by the Lake Carriers association that after midnight Nov. 19 the draft of vessels will have been reduced three inches. Vessels loading from Lake Superior to Lake Michigan or Lake Erie will be limited to a draft of 19 feet nine inches, from Lake Erie to Lake Superior 19 feet three inches, and from Lake Erie to Lake Michigan 19 feet nine inches.

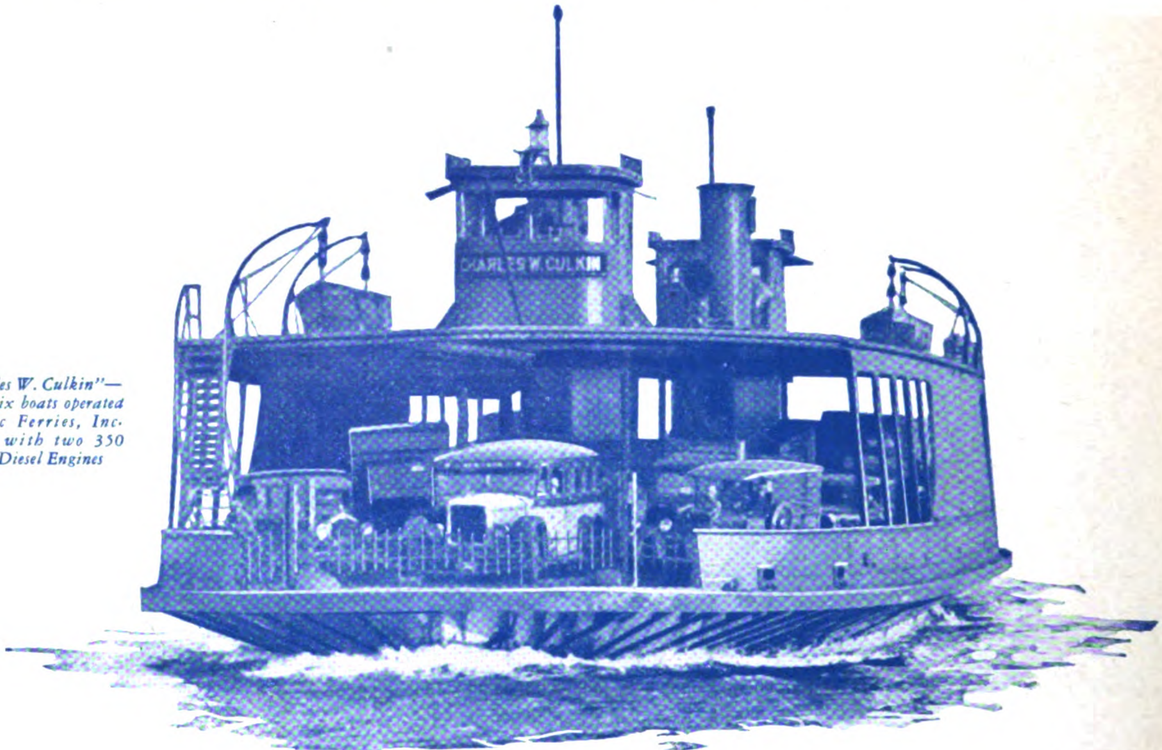
Marine Review

Reg. U.S. Pat. Off.

The National Publication Covering the Business of Transportation by Water

DECEMBER, 1928

"Do not believe any other engines could have given the satisfaction Nelseco's have"—J. E. PRICE



The "Charles W. Culkin"—one of the six boats operated by Electric Ferries, Inc. Equipped with two 350 B.H.P. Diesel Engines

J. E. Price, Marine Superintendent of Electric Ferries, Inc.

Is it any wonder that J. E. Price, Marine Superintendent of Electric Ferries, Inc., says of the 12 Nelseco Diesel engines installed in the 6 boats of his line—"I do not believe that any other engines in the world could have given the satisfaction that Nelseco's have."

The boats of Electric Ferries, Inc., average 18 trips an hour between New York and Weehawken, N. J., and return.

They carry an average of 3500 motor vehicles a day.

In 2 years they have never missed a trip on account of engine trouble.

In this time their engines have required only the most minor replacements.

Mr. Price has had 12 years of experience with many makes of Diesel engines. He prefers Nelseco Diesels to any others—because of their reliability, their accessibility and the fact that they require no expensive overhauling. In the two years that Electric Ferries, Inc., has been in operation there has been no necessity for replacing either bearings, pistons, or cylinder heads . . . and the actual cost for minor replacements over the two-year period since November 8, 1926, for 12 engines in 6 boats has been only $355.30.

No evidence of Nelseco superiority could be more convincing than their use by a ferry line whose growth and development depends upon the reliability of the service it offers.

Nelseco Diesel Engine, Type 6 MI-18, 350 B.H.P. at 280 R.P.M. 6 cylinder, mechanical injection

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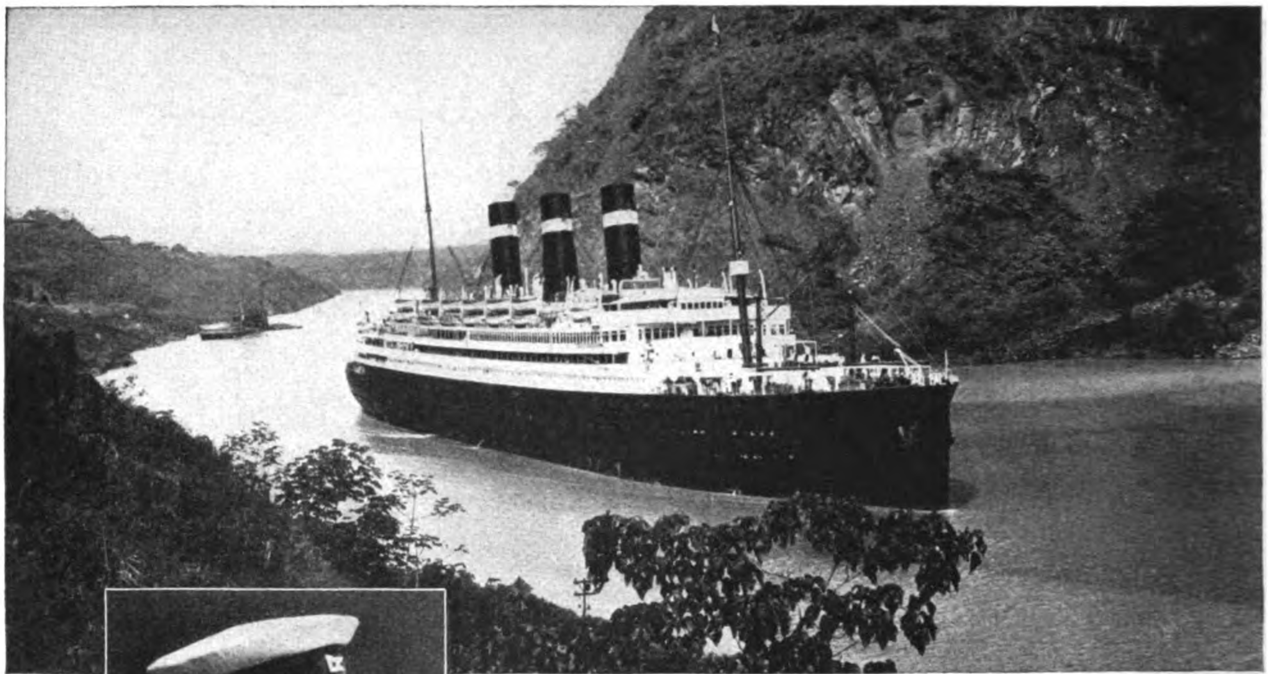

The *S. S. Belgenland* in the Culebra Cut, Panama Canal

J. Russell Mackay,
her Chief Engineer

A ship and an oil that go 'round the world

The *S. S. Belgenland* of the Red Star Line sails December 17 on a 4-months' cruise around the world. This triple-screw oil burner, with a gross tonnage of 27,200, has already made four successful cruises of this nature.

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Chief Engineer Mackay is one of the many marine engineers who have learned by experience the practical economies of these high-grade Gargoyle lubricants.

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Marine Review

The National Publication Covering the Business of Transportation by Water

CLEVELAND **FOUNDED 1878** **NEW YORK**

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A. H. Jansson, *Editor*
J. D. Pease, *Advertising Director*
F. V. Cole, *Circulation Manager*
H. O. Taylor

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A. G. Raufer

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L. C. Pelott
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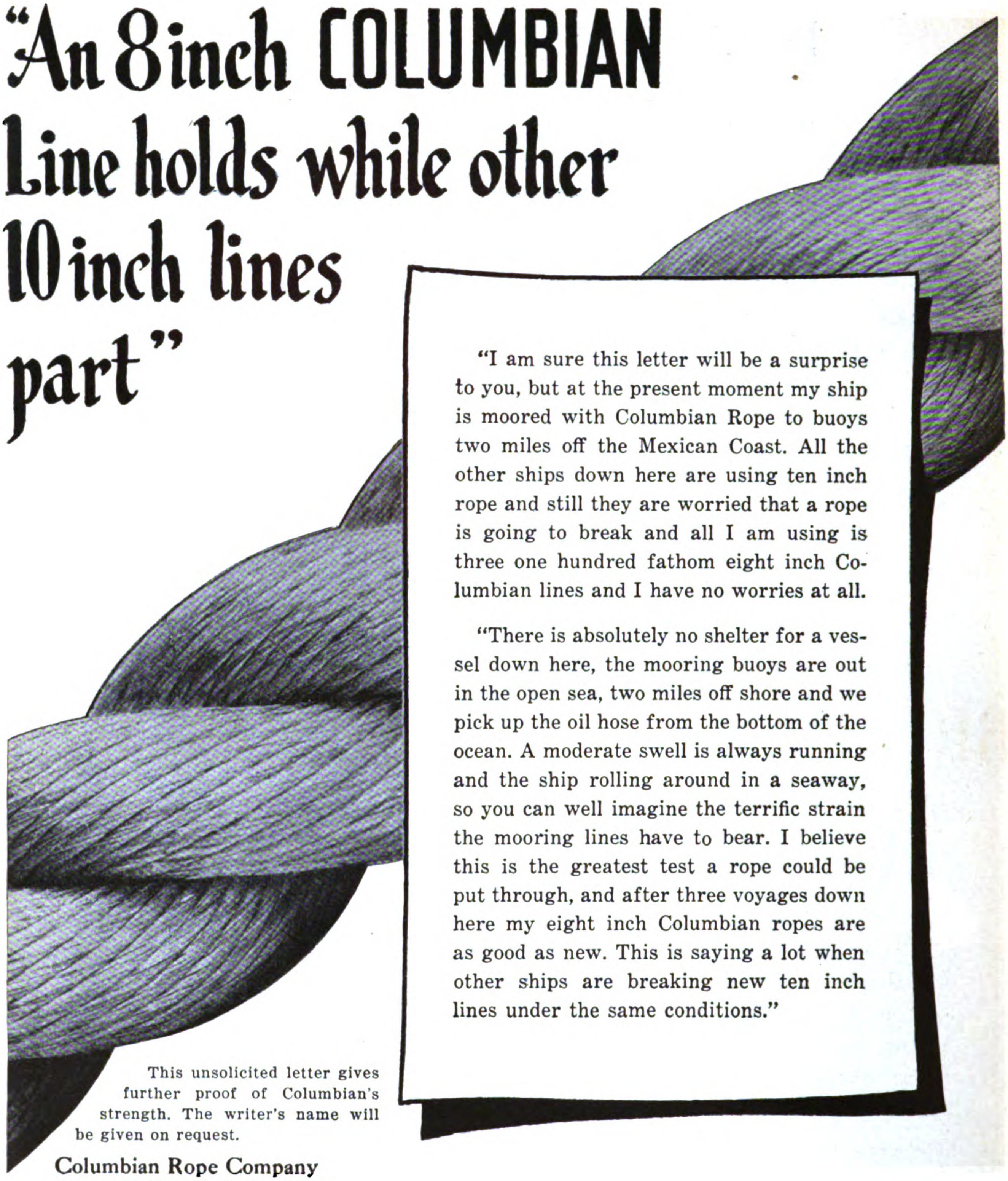
"An 8 inch COLUMBIAN Line holds while other 10 inch lines part"



"I am sure this letter will be a surprise to you, but at the present moment my ship is moored with Columbian Rope to buoys two miles off the Mexican Coast. All the other ships down here are using ten inch rope and still they are worried that a rope is going to break and all I am using is three one hundred fathom eight inch Columbian lines and I have no worries at all.

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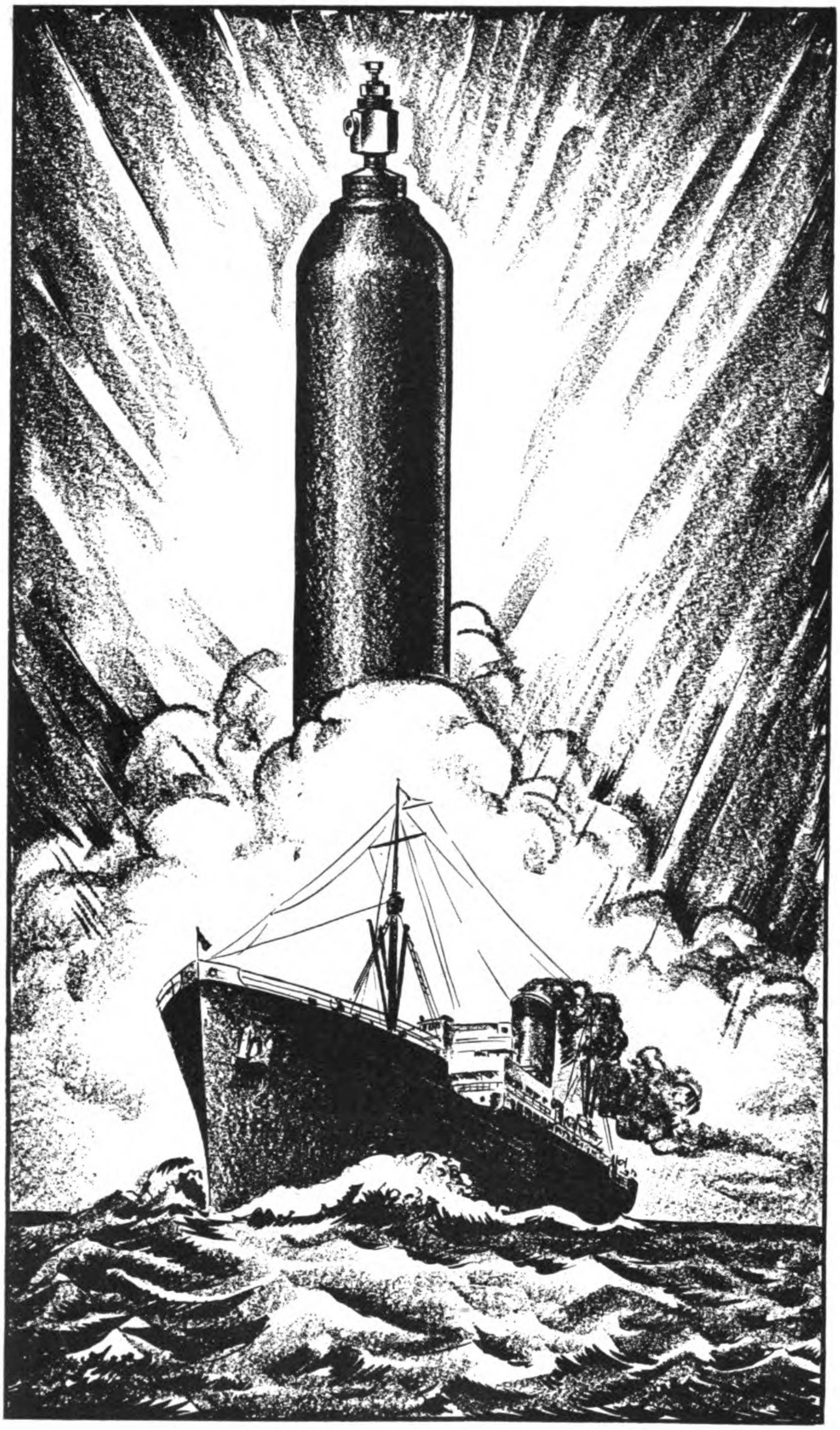

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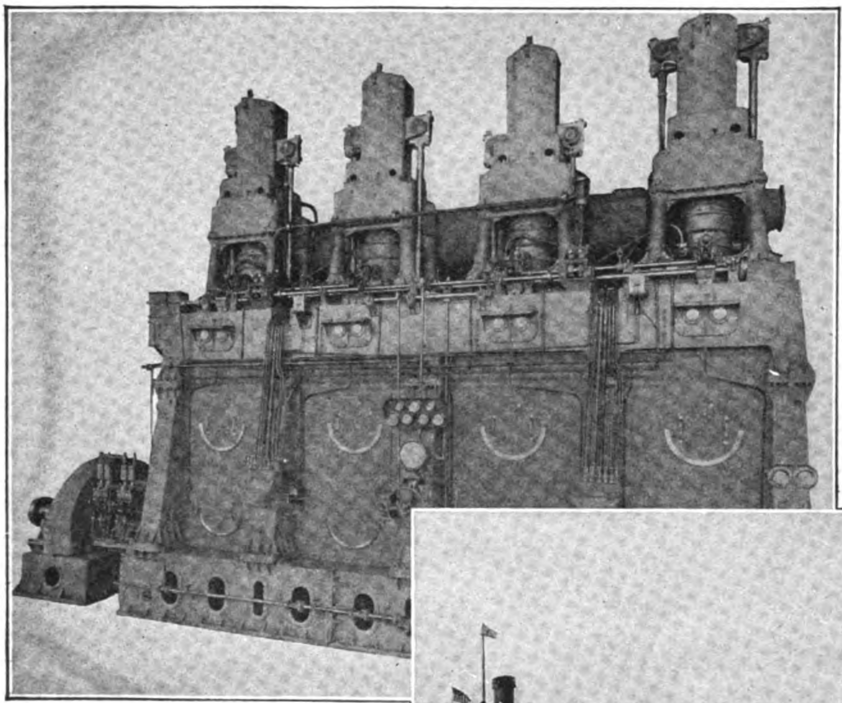
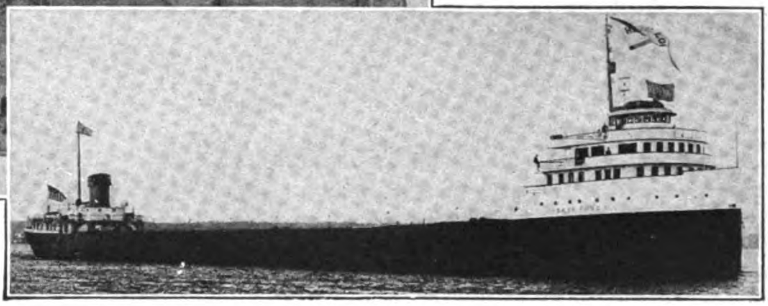


3000 S. H. P. Sun-Doxford Diesel Engines power the two motorships, "Henry Ford II" and "Benson Ford".



M. S. "Henry Ford II"

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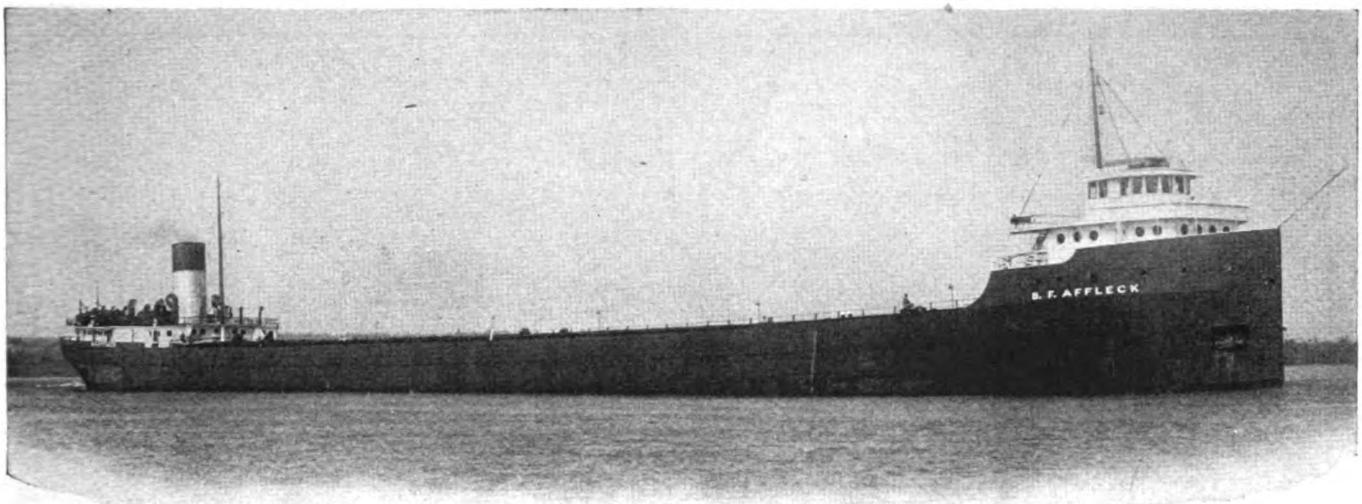

B. F. AFFLECK

Finest Type of Great Lakes Cargo Carrier

S.S. B. F. Affleck owned and operated by the Pittsburgh Steamship Company, is a single deck bulk cargo vessel of the standard type built for the iron ore, coal and stone trade of the Great Lakes. Her molded dimensions are: Length overall, 604 feet, length between perpendiculars, 580 feet; width 60 feet and depth 32 feet. Capacity 12,000 tons.

A diversified experience, covering the construction of all types of ships, fully qualifies us to meet *your* requirements thoroughly and with despatch.

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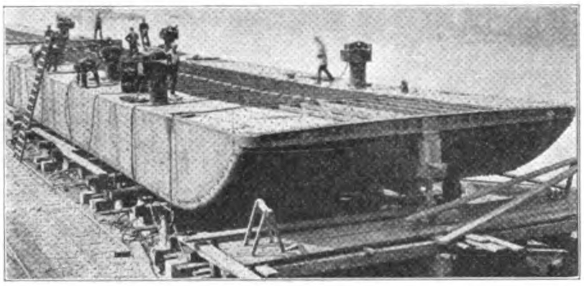


Progress Picture showing Steel Barges constructed for The Mississippi River Commission.

Barge Department
of
American Bridge Company

Builders of

STEEL BARGES

FOR RIVERS AND HARBORS

AMERICAN BRIDGE COMPANY

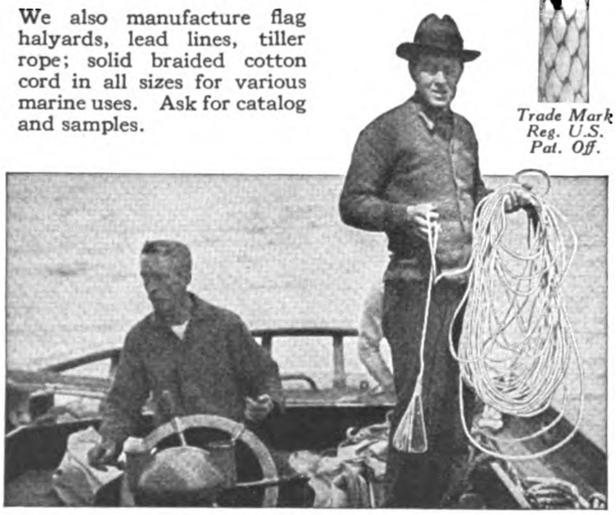
Frick Building **Pittsburgh, Penna.**

SAMSON SPOT
Log Lines

Smooth, tough and durable; no adulterating material to stiffen it and decrease strength and durability. Solid braided of extra quality cotton yarn. Uniform in size and quality. Easily identified by the colored spots, our trade mark.

We also manufacture flag halyards, lead lines, tiller rope; solid braided cotton cord in all sizes for various marine uses. Ask for catalog and samples.

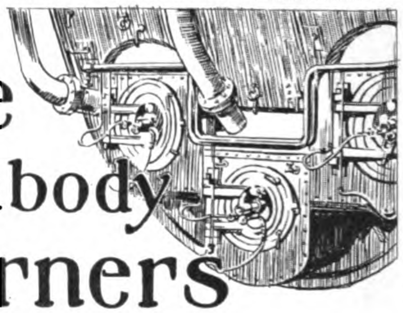
Trade Mark Reg. U.S. Pat. Off.



SAMSON CORDAGE WORKS

88 BROAD STREET BOSTON, MASS.

The Peabody Burners



on the test boiler at the Philadelphia Navy Yard proved that pulverized coal could be burned under Scotch marine boilers—**and the successful trips of the S. S. Mercer have demonstrated that Peabody Burners are practical.**

Ask our Engineers to tell you more about Peabody Pulverized Coal Firing Systems.

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112-114 East 42nd St., New York, N. Y.

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If you are thinking of using a gas range on your boat this coming season, remember that SHIPMATE gas ranges come from the makers of SHIPMATE coal ranges.

No further comment is necessary.

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THE STAMFORD FOUNDRY COMPANY

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Whitlock **WATERFLEX** Manila is *water-resisting;* the fibre remains permanently lubricated.

WATERFLEX rope is practically unaffected by dampness, rain or continued immersion in water.

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Annoyances caused by swelling, hardening and kinking are eliminated.

WATERFLEX when wet, remains flexible and continues to handle easily and to run smoothly through blocks and over sheaves. Even a new hawser of large size can be spliced readily *wet or dry.*

WATERFLEX may be left outdoors in all kinds of weather with the assurance of protection against deterioration or *wet rot*, which shortens the serviceable life of ordinary rope.

No additional charge is made for the patented **WATERFLEX** feature.

Our claims of absolute superiority for **WATERFLEX** cordage have been thoroughly proven in the most severe kinds of marine and other service.

Waterflex "Wet"

FIBORE—*the original Fibre-Core Rope*—made water-resisting by our **WATERFLEX** treatment, is unquestionably the strongest and most efficient type of large cordage ever developed.

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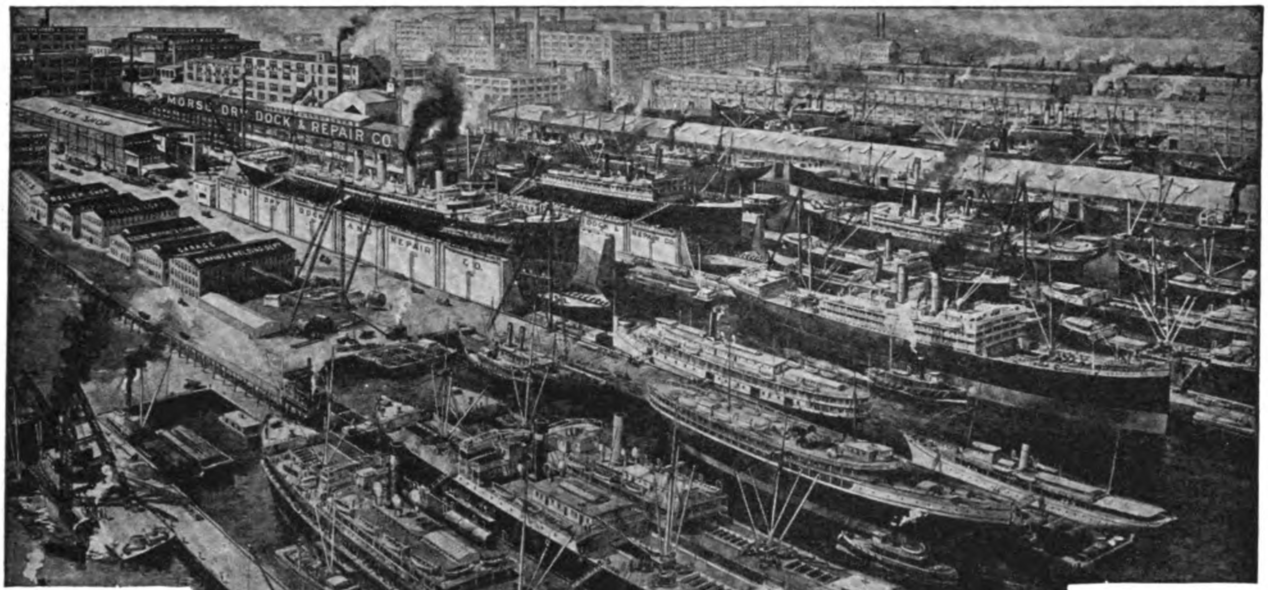

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Turbine Balancing

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Brooklyn, N.Y.	Brooklyn, N.Y.	New York City

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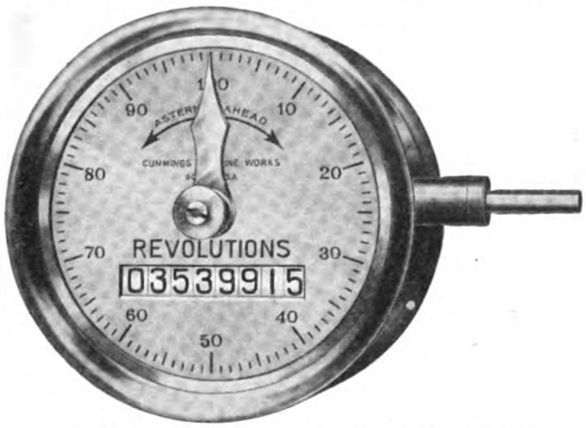
Combination Counter & Telltale



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Cummings Revolution Counters and
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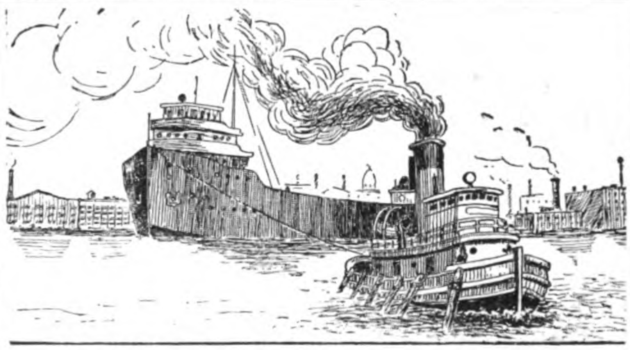

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255 Atlantic Ave., Boston, Mass.

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Westinghouse Electric & Mfg. Co.,
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American Bridge Co.
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Ellis Channel System, Inc.,
33 Rector St., New York City.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.

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Willard Storage Battery Co.,
246 E. 131st St., Cleveland, O.

BINNACLES
Ritchie, E. S., & Sons, Brookline, Mass.

BLOWERS (Flue)
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.

BLOWERS (Motor Driven Ventilation)
Diehl Manufacturing Co.,
Elizabethport, N. J.
Sturtevant, B. F., Co.,
Hyde Park, Boston, Mass.

BOATS (Steel and Wood)
Bath Iron Works Corporation, Bath, Maine.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.

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Hazel-Atlas Glass Co.,
16th and Market St., Wheeling, W. Va.

BOILERS
Washington Iron Works,
6th Ave. & Atlantic St., Seattle, Wash.

BOILERS (Marine)
Almy Water Tube Boiler Co.,
184 Allen St., Providence, R. I.
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.
Babcock & Wilcox Co.,
85 Liberty St., New York City.
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Great Lakes Engineering Works,
River Rouge, Mich.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.
Oldman-Magee Boiler Works, Inc.,
36-40 Illinois St., Buffalo, N. Y.
Sun Shipbuilding & Dry Dock Co.,
Chester, Pa.
Toledo Shipbuilding Co., Toledo, O.

BOILERS (Water Tube)
Almy Water Tube Boiler Co.,
184 Allen St., Providence, R. I.
Babcock & Wilcox Co., The,
85 Liberty St., New York City.

BOOKS (Technical)
Penton Publishing Co., Cleveland, O.

BRASS GOODS AND SPECIALTIES
Tiebout, W. & J.,
118 Chambers St., New York City

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Boland & Cornelius
Marine Trust Bldg., Buffalo, N. Y.
Farley, Edward P., & Co., Inc.,
11 Broadway, New York City.

BUNKER COAL
Port Huron Coal & Dock Co.,
1460 Union Trust Bldg., Cleveland, O.

BUNKER FUEL OIL—See FUEL OIL

BURNERS (Oil)—See OIL BURNING EQUIPMENT

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Columbian Rope Co., Auburn, N. Y.
Whitlock Cordage Co.,
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Stratford, Geo., Oakum Co.,
165 Cornelison Ave., Jersey City, N. J.

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Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Dake Engine Co., Grand Haven, Mich.
Hyde Windlass Co., Bath, Me.

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American Bridge Co.,
71 Broadway, New York City.
Ellis Channel System, Inc.,
33 Rector St., New York City.

CASTINGS
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Great Lakes Engineering Works,
River Rouge, Mich.
New London Ship & Engine Co.,
11 Pine St., New York City.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.

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Ellis Channel System, Inc.,
33 Rector St., New York City.

COAL
Port Huron Coal & Dock Co.,
1460 Union Trust Bldg., Cleveland, O.

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Cummings Machine Works,
255 Atlantic Ave., Boston, Mass.

COMPASSES
Ritchie, E. S., & Sons, Brookline, Mass.

COMPASSES (Gyro)
Sperry Gyroscope Co., Brooklyn, N. Y.

COMPRESSORS
Frick Company, Waynesboro, Pa.

CONDENSERS
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Great Lakes Engineering Works,
River Rouge, Mich.
Westinghouse Electric & Mfg. Co.,
So. Philadelphia, Pa.

CONTRACTORS (Electric)
Benson Electric Co., Superior, Wis.

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Collingwood Shipyards, Ltd.,
Collingwood, Ont., Canada.

CONTRARUDDER
Collingwood Shipyards, Ltd.,
Collingwood, Ont., Canada.

CORDAGE
Columbian Rope Co., Auburn, N. Y.
Samson Cordage Works, Boston, Mass.
Whitlock Cordage Co.,
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CORROSION PREVENTATIVE
United States Rubber Co.,
1790 Broadway, New York City.

CRANKSHAFTS
Erie Forge Co., Erie, Pa.

CRANKSHAFTS (Diesel Engine)
Titusville Forge Co., Titusville, Pa.

DIESEL ENGINES—See ENGINES (Diesel)

DIESEL FUEL OIL—See FUEL OIL

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Griscom-Russell Co.,
285 Madison Ave., New York City

DIVING APPARATUS
Morse, Andrew J., & Son, Inc.,
221 High St., Boston, Mass.

DRAFT (Artificial and Mechanical for Boilers)
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O
Great Lakes Engineering Works,
River Rouge, Mich
Sturtevant, B. F., Co.,
Hyde Park, Boston, Mass

DRAFT GAUGES
Peabody Engineering Corp.,
110 E. 42nd St., New York City

DREDGING MACHINERY
Great Lakes Engineering Works,
River Rouge, Mcih
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa

DRY DOCKS
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa
Great Lakes Engineering Works,
River Rouge, Mich.
Manitowoc Ship Building Corp.,
Manitowoc, Wis.
Maryland Dry Dock Co., Baltimore, Md.
Morse Dry Dock & Repair Co.,
Foot of 56th St., Brooklyn, N. Y.
Newport News Shipbuilding & Dry Dock Co.,
Sun Shipbuilding & Dry Dock Co.,
Chester, Pa.
Todd Shipyards Corp.,
25 Broadway, New York City.
Toledo Ship Building Co., Toledo, O.

DYNAMOS
Diehl Manufacturing Co., Elizabethport. N. J.
Engberg's Electrical & Mechanical Works, 22 Vine St., St. Joseph, Mich.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

EJECTORS (Ash)
Great Lakes Engineering Works, River Rouge, Mich.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

ENGINE SPEED INDICATORS
Sperry Gyroscope Co., Brooklyn, N. Y.

ENGINEERS (Marine, Mechanical and Consulting)
Crandall Engineering Co., 102 Border St., Boston, Mass.
Great Lakes Engineering Works, River Rouge, Mich.
McIntosh & Seymour Corp., Auburn, N. Y.
Maritime Engineering Corp., 205 W. Wacker Drive, Chicago, Ill.
Todd Shipyards Corp., 25 Broadway, New York City.

ENGINES
Bessemer Engine Co., Grove City, Pa.
Busch-Sulzer Bros.-Diesel Engine Co. 2nd & Utah Sts., St. Louis, Mo.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
New London Ship & Engine Co., 11 Pine St., New York City.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.

ENGINES (Diesel)
Bessemer Engine Co., Grove City, Pa.
Burmeister & Wain, Maskin-og Skibsbyggeri, Copenhagen, Denmark.
Busch-Sulzer Bros.-Diesel Engine Co., 2nd & Utah Sts., St. Louis, Mo.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
McIntosh-Seymour Corp., Auburn, N. Y.
New London Ship & Engine Co., 11 Pine St., New York City.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Washington Iron Works, 6th Ave. & Atlantic St., Seattle, Wash.

ENGINES (Hoisting)
Washington Iron Works, 6th Ave. & Atlantic St., Seattle, Wash.

ENGINES (Internal Combustion)
Bessemer Engine Co., Grove City, Pa.
Busch-Sulzer Bros.-Diesel Engine Co., 2nd & Utah Sts., St. Louis, Mo.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
McIntosh & Seymour Corp., Auburn, N. Y.

ENGINES (Logging)
Washington Iron Works, 6th Ave. & Atlantic St., Seattle, Wash.

ENGINES (Marine)
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.
Bath Iron Works Corporation, Bath, Maine.
Bessemer Engine Co., Grove City, Pa.
Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Busch-Sulzer Bros.-Diesel Engine Co., 2nd & Utah Sts., St. Louis, Mo.
Chicago Shipbuilding Co., South Chicago, Ill.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
McIntosh & Seymour Corp., Auburn, N. Y.
New London Ship & Engine Co., 11 Pine St., New York City.
Newport News Shipbuilding & Dry Dock Co., 233 Broadway, New York City.
Sturtevant, B. F., Co., Inc., Hyde Park, Boston, Mass.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Todd Shipyards Corp., 25 Broadway, New York City.
Toledo Ship Building Co., Toledo, O.

ENGINES (Oil)
Bessemer Engine Co., Grove City, Pa.
Busch-Sulzer Bros.-Diesel Engine Co., 2nd & Utah Sts., St. Louis, Mo.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
McIntosh & Seymour Corp., Auburn, N. Y.
New London Ship & Engine Co., 11 Pine St., New York City.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Washington Iron Works, 6th Ave. & Atlantic St., Seattle, Wash.

ENGINES (Steam, Steering)
Dake Engine Co., Grand Haven, Mich.

ENGINES (Vertical, Enclosed, Self Oiling)
Engberg's Electric & Mechanical Works, 22 Vine St., St. Joseph, Mich.

EUROPEAN STEAMSHIP LINES (Passenger and Freight)
Hamburg-American Line 39 Broadway, New York City.

EVAPORATORS
Griscom-Russell Co., 285 Madison Ave., New York City.

FANS (Desk & Bracket-Oscillating & Non-Oscillating)
Diehl Manufacturing Co., Elizabethport, N. J.

FANS (Electric)
Diehl Manufacturing Co., Elizabethport, N. J.
General Electric Co., Schenectady, N. Y.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS (Ventilating)
Diehl Manufacturing Co., Elizabethport, N. J.

FEED WATER HEATERS—See HEATERS AND PURIFIERS (Feed Water)

FEED WATER REGULATORS
Babcock & Wilcox Co., 85 Liberty St., New York City.

FIRE EXTINGUISHER
American-LaFrance & Foamite Corp., Elmira, N. Y.

FIRE EXTINGUISHING SYSTEMS
American-La France & Foamite Corp., Elmira, N. Y.

FIRE PROTECTION ENGINEERS
American-LaFrance & Foamite Corp., Elmira, N. Y.

FORGINGS
Erie Forge Co., Erie, Pa.

FORGINGS (Diesel Engine)
National Forge & Ordnance Co., Irvine, Warren Co., Pa.
Titusville Forge Co., Titusville, Pa.

FORGINGS (Hollow Bored)
National Forge & Ordnance Co., Irvine, Warren Co., Pa.

FORGINGS (Iron and Steel)
Titusville Forge Co., Titusville, Pa.

FORGINGS (Steel)
National Forge & Ordnance Co., Irvine, Warren Co., Pa.

FOUNDERS
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.

FREIGHT SERVICE
Hamburg-American Line, 39 Broadway, New York City.

FUEL DOCK
Port Huron Coal & Dock Co., 1460 Union Trust Bldg., Cleveland, O.

FUEL OIL
Texas Co., The, 17 Battery Place, New York City
Vacuum Oil Co., 61 Broadway, New York City.

FUEL OIL SYSTEMS
Peabody Engineering Corp., 110 E. 42nd St., New York City.

GALLEY RANGES
Stamford Foundry Co., Stamford, Conn.

GAS (Acetylene Dissolved)
Prest-O-Lite Co., Inc., 30 East 42nd St., New York City.

GAS (Nitrogen and Oxygen)
Linde Air Products Co., 30 East 42nd St., New York City.

GAS (Welding and Cutting)
Prest-O-Lite Co., Inc., 30 East 42nd St., New York City.

GEARS (Marine Equipment)
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

GENERATING SETS
Diehl Manufacturing Co., Elizabethport, N. J.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.

GENERATING SETS (Direct Connected)
Engberg's Electric & Mechanical Works, 22 Vine St., St. Joseph, Mich.
General Electric Co., Schenectady, N. Y.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

GENERATORS
Diehl Manufacturing Co., Elizabethport, N. J.
Engberg's Electric & Mechanical Works, 22 Vine St., St. Joseph, Mich.
Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GREASE
Texas Co., The, 17 Battery Place, New York City.
Vacuum Oil Co., 61 Broadway, New York City.

GREASE (Launching)
Texas Co., The, 17 Battery Place, New York City.
Vacuum Oil Co., 61 Broadway, New York City.

GYRO-PILOT (Automatic Steering)
Sperry Gyroscope Co., Brooklyn, N. Y.

HARDWARE (Marine) — See MARINE HARDWARE

HATCH FASTENERS
Mullholland Hatch-Fastener Co., Marion Bldg., Cleveland, O.

HAWSERS (Manila)
Columbian Rope Co., Auburn, N. Y.
Samson Cordage Works, Boston, Mass.
Whitlock Cordage Co., 46 South St., New York City.

HEATERS AND PURIFIERS (Feed Water)
Davis Engineering Co., 90 West St., New York City.
Griscom-Russell Co., 285 Madison Ave., New York City.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

HEATING EQUIPMENT
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

HEATING STOVES
Stamford Foundry Co., Stamford, Conn.

HOISTING ENGINES
Hyde Windlass Co., Bath, Me.

HOISTS (Air)
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.

HULLS (Steel)
Bath Iron Works Corporation, Bath, Maine.
Ellis Channel System, Inc., 33 Rector St., New York City.

ICE MACHINES — See REFRIGERATING MACHINERY

INDICATORS (Direction & Revolution)
Sperry Gyroscope Co., Brooklyn, N. Y.

INDICATORS (Helm Angle)
Sperry Gyroscope Co., Brooklyn, N. Y.

INDICATORS (Speed)
Sperry Gyroscope Co., Brooklyn, N. Y.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above

INSURANCE (Marine)
Boland & Cornelius,
Marine Trust Bldg., Buffalo, N. Y.

INTERNAL COMBUSTION ENGINES
Burmeister & Wain,
Maskin-og Skibsbyggeri, Copenhagen, Denmark

LAMPS (Mazda and Arc)
General Electric Co., Schenectady, N. Y.

LIFEBOATS
Lane, C. M., Lifeboat Co., Inc.,
856 Humboldt St., Brooklyn, N. Y.

LIFESAVING EQUIPMENT
Lane, C. M., Lifeboat Co., Inc.,
856 Humboldt St., Brooklyn, N. Y.

LIGHTING EQUIPMENT
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

LOGS (Patent)
Walker, Thomas, & Son, Ltd.,
58 Oxford St., Birmingham, England.

LUBRICATING OIL
Texas Co., The,
17 Battery Place, New York City.
Vacuum Oil Co.,
61 Broadway, New York City.

MACHINERY (Marine)
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.
Bath Iron Works Corporation, Bath, Maine.
Bessemer Engine Co., Grove City, Pa.
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Chicago Shipbuilding Co., So. Chicago, Ill.
Great Lakes Engineering Works,
River Rouge, Mich.
Manitowoc Ship Building Corp.,
Manitowoc, Wis.
Maryland Dry Dock Co., Baltimore, Md.
Toledo Ship Building Co., Toledo, O.
Washington Iron Works,
6th Ave. & Atlantic St., Seattle, Wash.

MACHINISTS
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.
Milwaukee Dry Dock Co., Milwaukee, Wis.
New London Ship & Engine Co.,
11 Pine St., New York City.
Washington Iron Works,
6th Ave. & Atlantic St., Seattle, Wash.

MANILA OAKUM—See OAKUM (Marine, Rope, Packings, Plumbers)

MARINE DECKING—See DECKING

MARINE ENGINES
Burmesiter & Wain,
Maskin-og Skibsbygerri, Copenhagen, Denmark

MARINE GLUE
Carpenter, Geo. B., & Co.,
436 N. Wells St., Chicago, Ill.

MARINE HARDWARE
Tiebout, W. & J.,
118 Chambers St., New York City.

MARINE RAILWAY BUILDERS
Crandall Engineering Co.,
102 Border St., Boston, Mass.

MARINE SUPPLIES
Carpenter, Geo. B., & Co.,
436 N. Wells St., Chicago, Ill.
Tiebout, W. & J.,
118 Chambers St., New York City.

MATERIAL HANDLING EQUIPMENT
Smith, Leathem D., Dock Co.,
Sturgeon Bay, Wis.

MOTOR GENERATOR SETS
Diehl Manufacturing Co.,
Elizabethport, N. J.
Engberg's Electric & Mechanical Works,
22 Vine St., St. Joseph, Mich.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

MOTORS (Electric)
Diehl Manufacturing Co.,
Elizabethport, N. J.
Engberg's Electric & Mechanical Works,
22 Vine St., St. Joseph, Mich.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

MOTORS (Winch)
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

NAUTICAL INSTRUMENTS
Carpenter, George B., & Co.,
436 N. Wells St., Chicago, Ill.
Ritchie, E. S., & Sons, Brookline, Mass.
Sperry Gyroscope Co., Brooklyn, N. Y.

NITROGEN (Gas)
Linde Air Products Co.,
30 East 42nd St., New York City.

OAKUM (Marine, Rope, Packings, Plumbers)
Stratford, George, Oakum Co.,
165 Cornelison Ave., Jersey City, N. J.

OIL BURNERS
Peabody Engineering Corp.,
110 E. 42nd St., New York City.

OIL BURNING EQUIPMENT
Babcock & Wilcox Co.,
85 Liberty St., New York City.
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Sturtevant, B. F., Co.,
Hyde Park, Boston, Mass.

OIL CLARIFIERS
Sharples Specialty Co.,
23rd & Westmoreland Sts., Philadelphia, Pa.

OIL FOR ALL PURPOSES (Marine)
Texas Co., The,
17 Battery Place, New York City.
Vacuum Oil Co.,
61 Broadway, New York City.

OIL PURIFIERS
Sharples Specialty Co.,
23rd & Westmoreland Sts., Philadelphia, Pa.

OXYGEN (Gas)
Linde Air Products Co.,
30 East 42nd St., New York City.

PACKING (Tarred and Untarred Jute)
Stratford, George, Oakum Co.,
Jersey City, N. J.

PASSENGER SERVICE
Hamburg-American Line,
39 Broadway, New York City.

PIPING (Cold Storage)
Frick Company, Waynesboro, Pa.

PLASTER FIBRE
Stratford, George, Oakum Co.,
Jersey City, N. J.

PLATES (Rolled Zinc)
Hazel-Atlas Glass Co.,
16th & Market St., Wheeling, W. Va.

PLUMBERS' OAKUM
Stratford, George, Oakum Co.,
Jersey City, N. J.

PORT FACILITIES
Newark, Port of
City Hall, Newark, N. J.

POWDERED COAL BURNERS
Peabody Engineering Corp.,
110 E. 42nd St., New York City.

PROPELLER BLADES AND HUBS
Sheriffs Mfg. Co., Milwaukee, Wis.

PROPELLER WHEELS
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.
Detroit Ship Building Co., Detroit, Mich.
Great Lakes Engineering Works,
River Rouge, Mich.
Milwaukee Dry Dock Co., Milwaukee, Wis.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.
Sheriffs Mfg. Co., Milwaukee, Wis.
Toledo Ship Building Co., Toledo, O.
Trout, H. G. Co.,
220 Ohio St., Buffalo, N. Y.

PROPELLERS
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Hyde Windlass Co., Bath, Me.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.

PUMPS
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
Great Lakes Engineering Works,
River Rouge, Mich.
Warren Steam Pump Co., Inc., Warren, Mass.
Waterous Co., The, St. Paul, Minn.

PUMPS (Ballast)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Warren Steam Pump Co., Inc., Warren, Mass.

PUMPS (Bilge)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
Warren Steam Pump Co., Inc., Warren, Mass.

PUMPS (Boiler Feed)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
Warren Steam Pump Co., Inc., Warren, Mass.

PUMPS (Direct Acting)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.

PUMPS (Power)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.

PUMPS (Rotary)
Waterous Co., The, St. Paul, Minn.

PUMPS (Steam)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.
Fairbanks, Morse & Co.,
900 South Wabash Ave., Chicago, Ill.
Warren Steam Pump Co., Inc., Warren, Mass.

PUMPS (Vacuum)
Dean Brothers Co.,
323 W. Tenth St., Indianapolis, Ind.

PURIFICATION SYSTEMS—See WATER PURIFICATION SYSTEMS

PURIFIERS (Oil)
Sharples Specialty Co.,
23rd & Westmoreland Sts., Philadelphia, Pa.

RADIO COMPASS AND DIRECTION FINDER
Radiomarine Corp. of America,
66 Broad St., New York City.

RADIO EQUIPMENT
Radiomarine Corp. of America,
66 Broad St., New York City.

RAFTS
Lane, C. M., Lifeboat Co., Inc.,
856 Humboldt St., Brooklyn, N. Y.

RAILWAY DRY DOCKS
Crandall Engineering Co.,
102 Border St., Boston, Mass.

RANGES
Stamford Foundry Co., Stamford, Conn.

REFRIGERATING MACHINERY
Frick Company, Waynesboro, Pa.

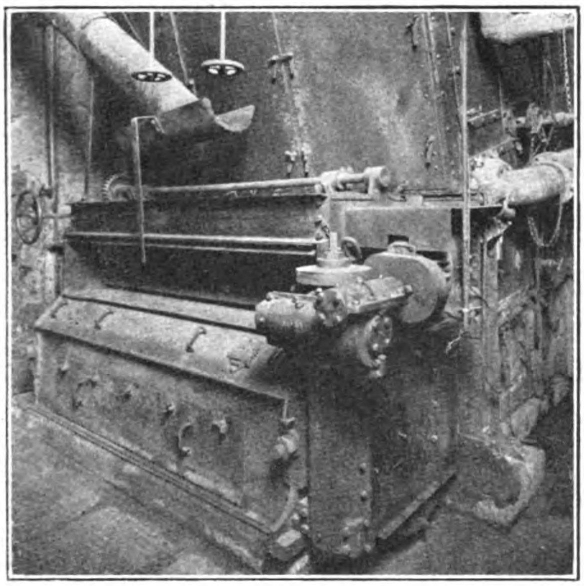
REPAIRS
Maryland Dry Dock Co., Baltimore, Md.

REPAIRS (Electric)
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

REPAIRS (Marine)
American Shipbuilding Co.,
Foot of W. 54th St., Cleveland, O.
Bethlehem Shipbuilding Corp., Ltd.,
Bethlehem, Pa.
Chicago Shipbuilding Co., So. Chicago, Ill.
Great Lakes Engineering Works,
River Rouge, Mich.
Manitowoc Ship Building Corp.,
Manitowoc, Wis.
Newport News Shipbuilding & Dry Dock Co.,
233 Broadway, New York City.
Sun Shipbuilding & Dry Dock Co.,
Chester, Pa.
Todd Shipyards Corp.,
25 Broadway, New York City.
Toledo Ship Building Co., Toledo, O.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above

10 to 15 Per Cent Saving in Coal



BABCOCK & WILCOX FORCED BLAST CHAIN GRATE STOKERS

When fitted to Babcock & Wilcox marine boilers mean:

At least ten per cent saving in coal over hand firing

More flexible than hand firing when maneuvering

Efficient burning of a wide variety of coals

Simplicity in ash removal

Light labor in operation

Reduction in personnel with the larger installations

Particulars on request

THE BABCOCK & WILCOX CO.

Manufacturers of Marine Water Tube Boilers Since 1895

Sheldon Building SAN FRANCISCO	85 Liberty St. NEW YORK, N. Y.	Guardian Building CLEVELAND, O.

Locks and Latches *for* Doors and Hatches

In constructing ships of all types material savings are made possible by using Tiebout standardized hardware and supplies.

It is Tiebout's privilege to co-operate with ship and boat builders by supplying standardized equipment from stock at lowest prices.

W. & J. TIEBOUT

Marine Hardware

118 Chambers Street **New York**

ROLLED ZINC COILS STRIPS

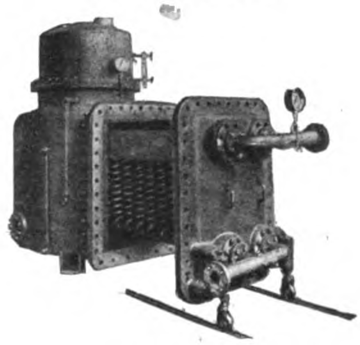
ZINC BOILER PLATES

Registered Trade Mark

HAZEL-ATLAS GLASS CO.
ROLLING MILLS
WHEELING, W. VA.

Eastern Sales Office—53 Park Pl., N Y C
Western Sales Office—202 Davis St , San Francisco Cal
Southern Sales Office—505 Marine Bk Bldg., New Orleans, La

The Evaporator that sheds scale



G-R Bentube Evaporator

Assures pure boiler feed
Automatically sheds scale
Increases boiler capacity

Write for bulletin

The Griscom-Russell Co.
285 Madison Ave., New York
Chicago Office: Monadnock Bldg.

REPAIRS (Marine Engines)
Bath Iron Works Corporation, Bath, Maine.
Collingwood Shipyards, Ltd., Collingwood, Ont., Canada
New London Ship & Engine Co., 11 Pine St., New York City.

REPAIRS (Turbine)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

REVOLUTION COUNTERS
Cummings Machine Works, 255 Atlantic Ave., Boston, Mass.
Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn, N. Y.

ROPE (Manila, Net, Sisal, and Other Hard Fiber Cordage)
Columbian Rope Co., Auburn, N. Y.
Samson Cordage Works, Boston, Mass.
Whitlock Cordage Co., 46 South St., New York City.

ROPE (Transmission)
Columbian Rope Co., Auburn, N. Y.

ROPE OAKUM
Stratford, George, Oakum Co., Jersey City, N. J.

RUBBER SLEEVES
United States Rubber Co., 1790 Broadway, New York City.

RUST PREVENTATIVE (Oil)
Texas Co., The, 17 Battery Place, New York City.
Vacuum Oil Co., 61 Broadway, New York City.

SAFETY VALVES (Marine)
Star Brass Mfg. Co., 53 Oliver St., Boston, Mass.

SCHOONERS (Auxiliary)
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.
Chicago Shipbuilding Co., So. Chicago, Ill.
Milwaukee Dry Dock Co., Milwaukee, Wis.
Toledo Ship Building Co., Toledo, O.

SEARCHLIGHTS (High Intensity)
Sperry Gyroscope Co., Brooklyn, N. Y.

SEARCHLIGHTS (Incandescent and Arc)
General Electric Co., Schenectady, N. Y.
Sperry Gyroscope Co., Brooklyn, N. Y.

SELF UNLOADING EQUIPMENT
Smith, Leathem D., Dock Co., Sturgeon Bay, Wis.

SEPARATORS (Oil)
Babcock & Wilcox Co., 85 Liberty St., New York City.
Sharples Specialty Co., 23rd & Westmoreland Sts., Philadelphia, Pa.

SHAFTING COVERING
Paper & Textile Machinery Co., Sandusky, O.
United States Rubber Co., 1790 Broadway, New York City.

SHIPBUILDERS
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.
Bath Iron Works Corporation, Bath, Maine.
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.
Collingwood Shipyards, Ltd., Collingwood, Ont., Canada.
Great Lakes Engineering Works, River Rouge, Mich.
Manitowoc Ship Building Corp., Manitowoc, Wis.
Maryland Dry Dock Co., Baltimore, Md.
Newport News Shipbuilding & Dry Dock Co., 233 Broadway, New York City.
Smith, Leathem D., Dock Co., Sturgeon Bay, Wis.
Sun Shipbuilding & Dry Dock Co., Chester, Pa.
Todd Shipyards Corp., 25 Broadway, New York City.
Toledo Ship Building Co., Toledo, O.

SHIPBUILDING SYSTEMS
Isherwood, J. W., 17 Battery Place, New York City.

SHIP CONSTRUCTION (Channel System)
Ellis Channel System, Inc., 33 Rector St., New York City.

SHIP LOGS
Walker, Thomas, & Son, Ltd. 58 Oxford St., Birmingham, England.

SHIP REPAIR (Marine)
Collingwood Shipyards, Ltd., Collingwood, Ont., Canada.

SHIP REPAIRS
Bath Iron Works Corporation, Bath, Maine.
Morse Dry Dock & Repair Co., Foot of 56th St., Brooklyn, N. Y.

SHIP STABILIZERS
Sperry Gyroscope Co., Brooklyn, N. Y.

SLEEVES (Rubber)
Paper & Textile Machinery Co., Sandusky, O.
United States Rubber Co., 1790 Broadway, New York City.

SPUN OAKUM
Stratford, George, Oakum Co., Jersey City, N. J.

STEAMSHIP LINES (Passenger and Freight)
Hamburg-American Line, 39 Broadway, New York City.

STEAM GAGES
Star Brass Mfg. Co., 53 Oliver St., Boston, Mass.

STEAM TRAPS
Davis Engineering Co., 90 West St., New York City.

STEEL BARGES—See BARGES (Steel)

STEERING ENGINES
Hyde Windlass Co., Bath, Me.

STEERING ENGINES (Electric)
Benson Electric Co., Superior, Wis.

STEERING GEARS
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.
Hyde Windlass Co., Bath, Me.

STEERING GEARS (Electric)
Benson Electric Co., Superior, Wis.

STEERING MOTOR (Electric)
Benson Electric Co., Superior, Wis.

STORAGE BATTERIES—See BATTERIES

STOVES
Stamford Foundry Co., Stamford, Conn.

SWITCHBOARDS
Engberg's Electric & Mechanical Works, 22 Vine St., St. Joseph, Mich.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TELEMOTORS
Benson Electric Co., Superior, Wis.
Hyde Windlass Co., Bath, Me.

TORSION METERS
Cummings Machine Works, 255 Atlantic Ave., Boston, Mass.

TOWING LINES
Columbian Rope Co., Auburn, N. Y.
Whitlock Cordage Co., 46 South St., New York City.

TRANSMISSION (Rope)—See ROPE (Transmission)

TRIMMERS
Benson Electric Co., Superior, Wis.

TUBES (Boiler, Stay, Yarrow)
Keating, E. F., Co., 446 Water St., New York City.

TURBINES (Electric)
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

TURBINES (Marine)
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.
Newport News Shipbuilding & Dry Dock Co., 233 Broadway, New York City.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

TURBINES (Steam)
De Laval Steam Turbine Co., Trenton, N. J.
Newport News Shipbuilding & Dry Dock Co., 233 Broadway, New York City.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., So. Philadelphia, Pa.

TWINE AND ROPE
Columbian Rope Co., Auburn, N. Y.
Samson Cordage Works, Boston, Mass.
Whitlock Cordage Co., 46 South St., New York City

VALVES AND FITTINGS
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.

VENTILATING EQUIPMENT
Diehl Manufacturing Co., Elizabethport, N. J.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.

WAREHOUSE FACILITIES
Newark, Port of City Hall, Newark, N. J.

WASTE (Cotton Wiping, White and Colored)
Stratford, Geo., Oakum Co., Jersey City, N. J.

WATER PURIFICATION SYSTEMS
Griscom-Russell Co., 285 Madison Ave., New York City.

WELDERS (Electric Arc)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WELDING AND CUTTING GAS
Prest-O-Lite Co., Inc., 30 East 42nd St., New York City.

WHISTLES
Star Brass Mfg. Co., 53 Oliver St., Boston, Mass.

WHISTLES (Electric)
Benson Electric Co., Superior, Wis.

WINCHES
Benson Electric Co., Superior, Wis.
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.
Dake Engine Co., Grand Haven, Mich.
Hyde Windlass Co., Bath, Me.

WINCHES (Electric)
Benson Electric Co., Superior, Wis.

WINDLASSES
American Shipbuilding Co., Foot of W. 54th St., Cleveland, O.
Bethlehem Shipbuilding Corp., Ltd., Bethlehem, Pa.
Carpenter, George B., & Co., 436 N. Wells St., Chicago, Ill.
Dake Engine Co., Grand Haven, Mich.
Hyde Windlass Co., Bath, Me.

WIRELESS MESSAGE SERVICE
Radiomarine Corp. of America, 66 Broad St., New York City

WIRELESS SETS AND APPARATUS
Radiomarine Corp. of America, 66 Broad St., New York City.

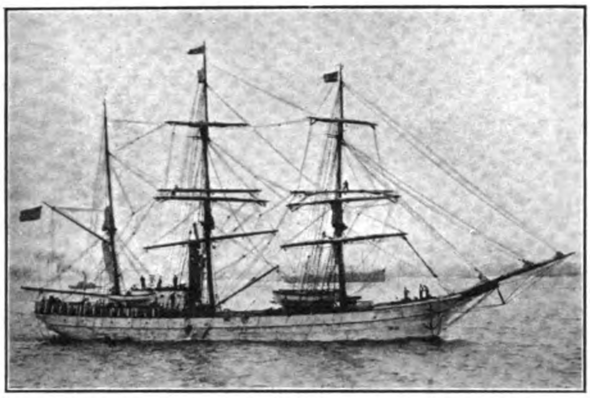
WORKBOATS
Lane, C. M., Lifeboat Co., Inc., 856 Humboldt St., Brooklyn, N. Y.

YACHTS (Sail, Steam and Diesel)
Bath Iron Works Corporation, Bath, Maine.

ZINC (Plates Rolled)
Hazel-Atlas Glass Co., 16th & Market St., Wheeling, W. Va.

ZINC PRODUCTS
Hazel-Atlas Glass Co., 16th & Market St., Wheeling W. Va.

See Index to Advertisements for Pages Containing Advertisements of Companies Listed Above


AUXILIARY BARKENTINE CITY OF NEW YORK
BYRD ANTARCTIC EXPEDITION

LANE LIFEBOATS
WERE SUPPLIED TO THE
BYRD ANTARCTIC EXPEDITION
C. M. Lane Lifeboat Co., Inc.
Brooklyn, N. Y.

BOILER TUBES
Seamless Steel—Charcoal Iron—Lapwelded Steel
Marine and Stay Tubes with Marine Certificates
E. F. KEATING CO.
Est. 1885
446-454 Water St., New York, N. Y.
Immediate Shipment from New York Stock
Telephone Orchard 9700

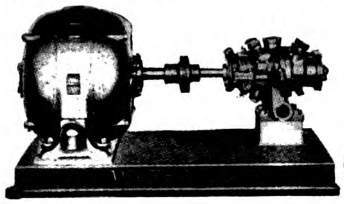
ANDREW J. MORSE & SON, Inc.
221 High Street BOSTON, MASS.
Established 1837
Diving Apparatus and Submarine Armor
Fire Department Supplies
The Morse Monitor Nozzle
Callahan Shut-Off Nozzle

THE MULHOLLAND HATCH-FASTENER COMPANY
Marion Building, Main 0272 Cleveland, Ohio
Manufacturers of the Mulholland Simplex and Security Hatch Fasteners.
For Ocean and Lake Trade
OVER 225,000 SETS NOW IN USE ON THE GREAT LAKES

Propeller Wheels and Blades
to fit any hub.
Sheriffs Manufacturing Co.
Established 1854
Milwaukee, Wis.

HAMBURG-AMERICAN LINE
Passenger Services: New York to Cherbourg, Southampton and Hamburg. New York to Cobh (Queenstown), Cherbourg and Hamburg
Pleasure Cruises: Around the World, to the West Indies, to Northern Wonderlands and to the Mediterranean
Freight Services: New York to Hamburg direct. Boston to Hamburg (via New York). Philadelphia, Baltimore and Norfolk to Bremen and Hamburg
Also direct freight service from North Pacific Ports to Hamburg, Bremen and Antwerp
HAMBURG-AMERICAN LINE
39 Broadway New York

"The Waterous Rotary Pump"
The Waterous Rotary Pump was developed in the fire fighting field. To meet the exacting demands placed upon it, a fire pump must be built simple and fool proof; it must be compact and highly efficient. These are reasons why the Waterous is probably the ideal rotary pump for your work. Complete information for the asking.



Waterous Dependable
WATEROUS COMPANY
Saint Paul Minnesota
Agents in Principal Cities

Leathem D. Smith Dock Co.
Sturgeon Bay, Wisconsin

Self-Unloading Boats our Specialty
Steel Fish Tugs and Barges
Wood and Steel Repair Work

•1

Classified Advertisements

For Sale and Miscellaneous—Help and Positions Wanted

For Sale and Miscellaneous Advertisements
10c per word—minimum advertisement—$3.00

Six words must be added for box address.

To insure insertion, advertisements must reach us by the 10th of the month.

Help Wanted Advertisements
6c per word—minimum advertisement—$3.00

Position Wanted Advertisements
4c per word—minimum advertisement—$1.00

Please have remittance accompany order.

Wanted

WANTED TO BUY—SMALL TANKER OR tanker barge. Must be clean enough for gasoline. Prefer one already on Atlantic Seaboard or Gulf of Mexico. Independent Oil Company, 1377 Southwest 8th St., Miami, Fla.

WANTED—ONE WOODEN AUXILIARY Schooner of the following approximate dimensions: O. A. Length 110', Beam 23', Draught 10', Speed under sails and motor 10 knots, Engine 200 HP. Address: MARINE REVIEW, Box 396, Cleveland.

For Sale

FOR SALE ONE DERRICK SCOW, 143 FT. long, 40 ft. beam, 800 ton capacity with cargo box 6 ft. 10 in. high, capacity 650 yds. Also one Deck Scow, 3,000 ton capacity, 160 ft. long, 40 ft. beam. Both in good operating condition. Further particulars upon request. Address: National Sand & Material Company, Ltd., Welland, Ontario.

SELF UNLOADER STEAMER LOUIS RAHlow For Sale: Length 155' x 30' x 11"; 366 Gross tons, 290 net tons. In good condition. Class 90. Can be seen Oswego. Capt. A. McDonald, 71 W. Third St., Oswego, N. Y.

For Sale

FOR SALE: MARINE ENGINES AND boilers of all sizes, light draft wooden and steel tug boats for sale or charter, derrick boats, deck scows and lighters for sale or charter. Cowles' Towing Co., Ohio St., Buffalo, N. Y.

FOR SALE. 1 F. & A. COMPOUND ENGINE 20 x 40 x 30. Can be used for either American or Canadian boat. Also machinery and boilers. REID TOWING & WRECKING CO., Limited, Sarnia, Ontario.

TO OUR SUBSCRIBERS

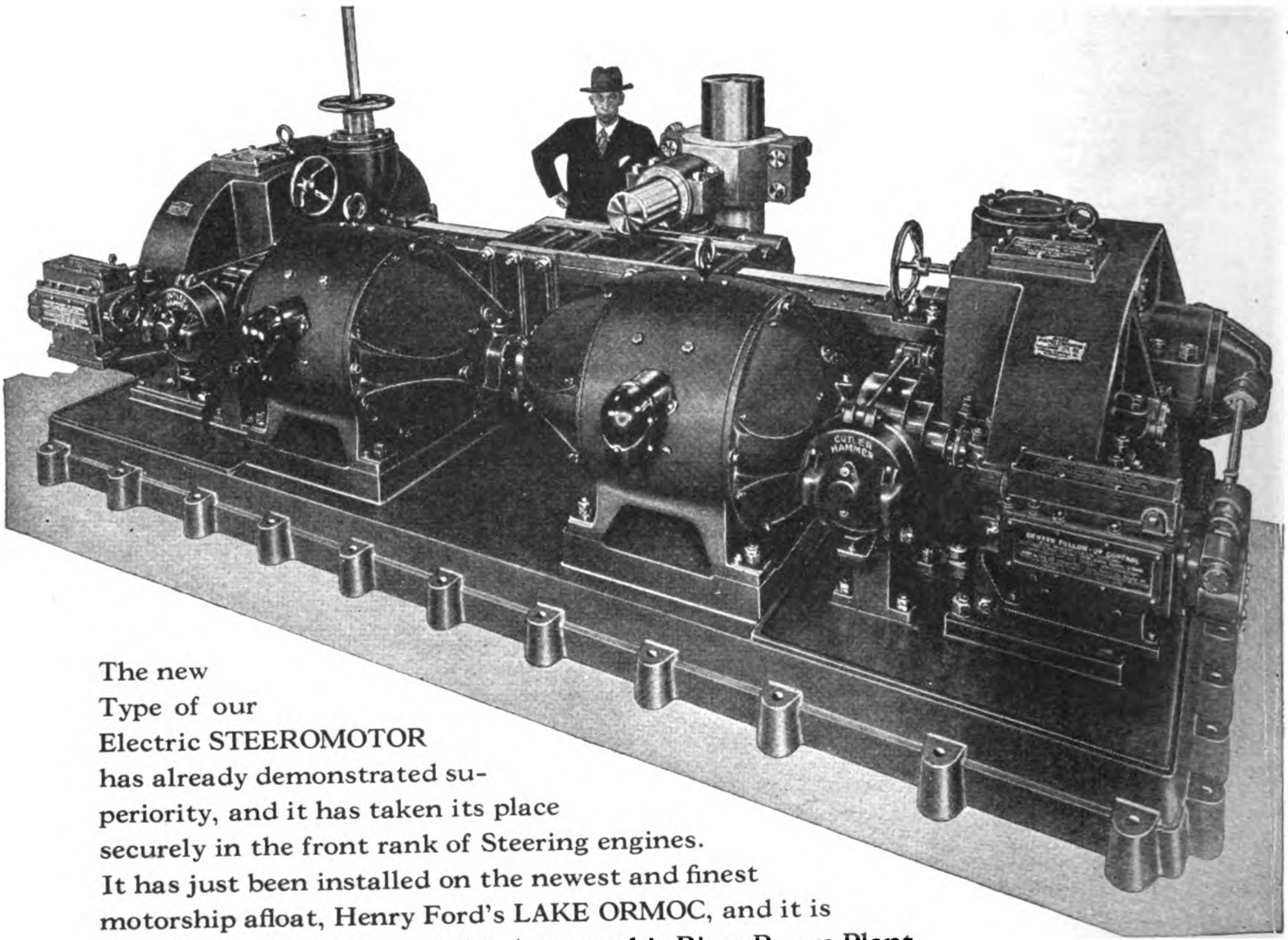
The classified section of MARINE REVIEW is for your convenience —its value is proving very worthwhile to everyone who uses it to buy and sell.

If you want to buy or sell ships or marine equipment—need a man for your organization—make it known to the entire marine industry through the use of classified advertising in MARINE REVIEW.

Mail copy for your advertisement in the January issue today, so it reaches us before Descember 20.

Index to Advertisements

Steering *You* Straight!



The new
Type of our
Electric STEEROMOTOR
has already demonstrated superiority, and it has taken its place securely in the front rank of Steering engines.
It has just been installed on the newest and finest motorship afloat, Henry Ford's LAKE ORMOC, and it is **already steering that good ship between his River Rouge Plant and his Rubber Plantation in Brazil.**

Simple—Dependable—Efficient—Quiet

Best for both steam and electrically operated ships.
But it is especially fitted for Diesel operated ships.
Will straighten the course and better the speed of any ship.

When considering steerers let us tell you about the

Johnson Type Steeromotor

Benson Electric Company

SUPERIOR, WISCONSIN

Also manufacturers Electric Winches and Electric Whistles

BUNKER COAL

—Day & Night Watches—

FAST FUELING

Twenty-four hour service
The fastest and most up-to-date

FUEL DOCK
on the Great Lakes

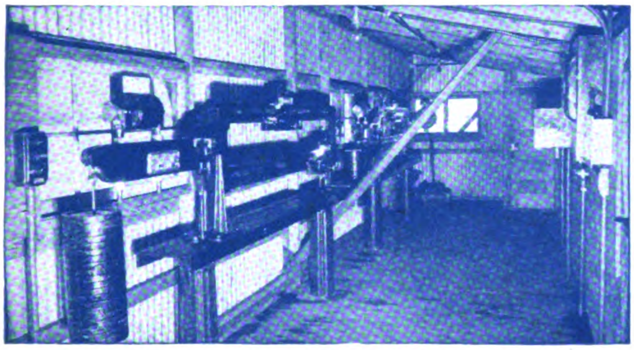
Storage capacity in elevated bins 700 tons. Specially designed Fairbanks Scales accurately weigh every *pound* of coal that passes into your bunker.

—at Port Huron on St. Clair River beside International Tunnel

Best West Virginia Coal.

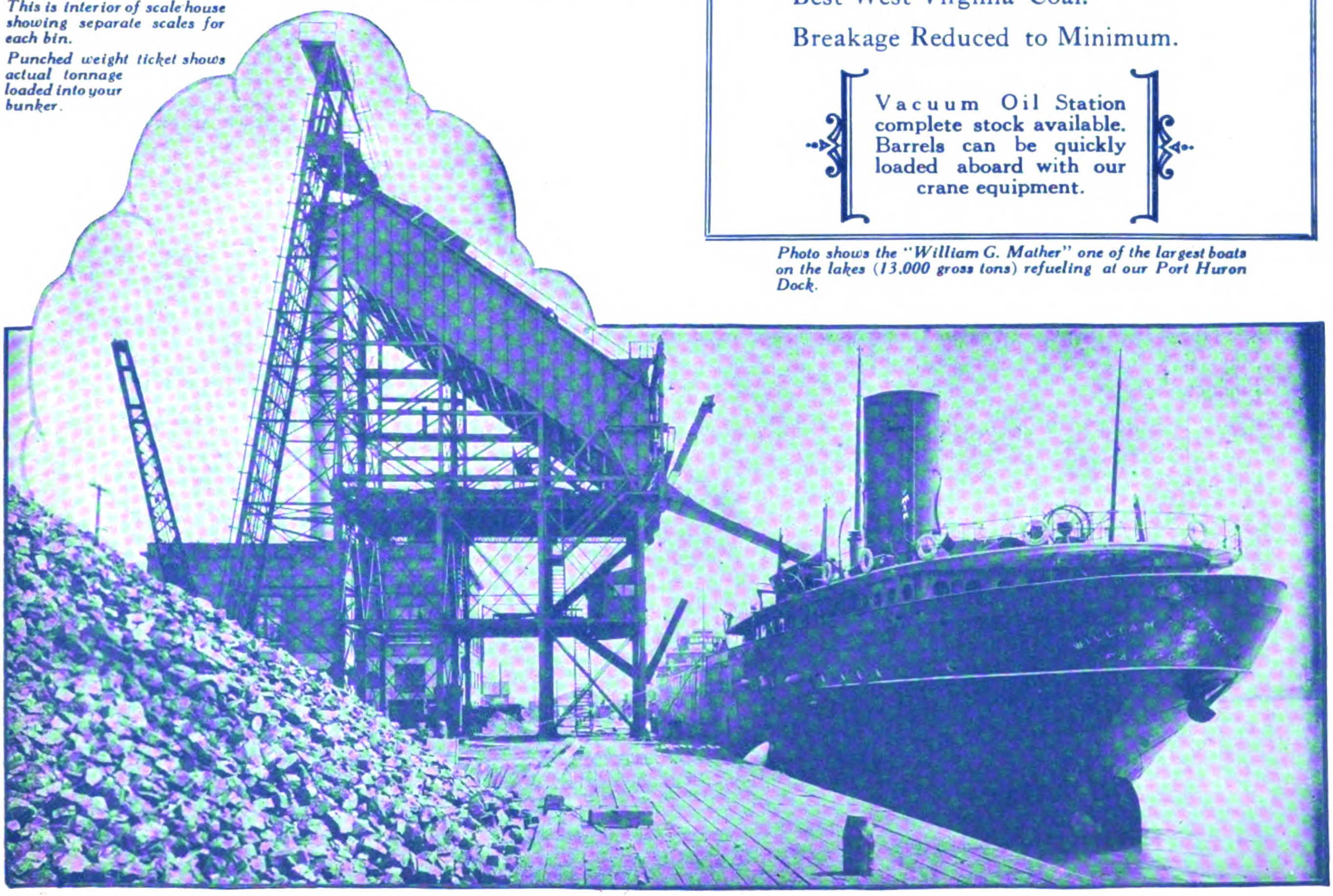
Breakage Reduced to Minimum.

Vacuum Oil Station complete stock available. Barrels can be quickly loaded aboard with our crane equipment.



This is interior of scale house showing separate scales for each bin.
Punched weight ticket shows actual tonnage loaded into your bunker.

Photo shows the "William G. Mather" one of the largest boats on the lakes (13,000 gross tons) refueling at our Port Huron Dock.



PORT HURON COAL & DOCK COMPANY

PORT HURON, MICHIGAN
EXECUTIVE OFFICES—1460 UNION TRUST BLDG., CLEVELAND, OHIO